Quantifying Children’s Exposure to Outdoor Food Advertising

Michelle Barr

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Abstract

The marketing of unhealthy food is a key modifiable influence on children’s dietary behaviours and childhood obesity. The WHO Commission on Ending Childhood Obesity (ECHO) has recommended that settings where children gather be free of unhealthy food marketing. Internationally, there are no data available that quantify children’s exposure to outdoor food advertising in public places. This study investigated the extent and nature of children’s exposure to outdoor food advertising overall, and on the journey to and from school.

A random sample of 168 children (aged 11-13y) from 16 randomly selected schools in Wellington, New Zealand wore cameras that took pictures automatically every 7s and a GPS device for four days. Using bespoke software, images were coded for outdoor food advertising using a pre-determined coding schedule. The advertised food products were classified as ‘core’ or ‘non-core’ using an accepted nutrient profiling system. The rate of core and non-core outdoor advertising exposures on journeys to and from school, and outside of school hours, were analysed overall, and by ethnicity and socioeconomic deprivation.

Overall, children were exposed to a mean of 8.3 food advertisements for each hour they spent in outdoor settings. Of these advertisements, 7.4 (89.2%) were for non-core and 0.8 (9.6%) were for core food advertisements. Exposure to non-core outdoor food advertising was highest among Māori participants. The most frequent non-core exposures were advertisements for fast food, sweet drinks, ice creams, and cookies. Both non-core and core advertising exposures were concentrated around food outlets, convenience stores, and on main roads. On the journey to and from school, the extent of children’s exposure to non-core and core advertising was associated with the presence of convenience stores and shopping areas along the routes they travelled.
To our knowledge, this is the first study internationally to objectively document and quantify the rate at which children encounter outdoor food advertising. The findings of this research suggest that outdoor food advertising is a significant source of children’s exposure to non-core food advertising, irrespective of whether they are the target audience. This research suggests that to reduce the extent and power of food advertising, as recommended by the ECHO report, urgent action must be taken by local government to remove unhealthy food advertisements from public places, particularly along major roadways and at shop fronts. This work extends previous research by providing evidence that children are exposed to unhealthy food advertising, not only in the places where they are known to gather but also across the spectrum of their everyday environments. Further, this research highlights that the advertising standards codes that regulate the promotion of food to New Zealand children are inadequate and must be strengthened to protect children from harmful food advertising. Implementing these measures would likely reduce the influence of food advertising on children and should be included as part of a comprehensive strategy to address childhood obesity in New Zealand. Although this study was conducted in New Zealand, the findings of this research are likely relevant for policy makers in other jurisdictions as outdoor advertising is a prominent feature in many cities across the world. Restricting outdoor advertising in cities and urban areas would, as part of a comprehensive strategy, likely improve dietary behaviours, reduce childhood obesity, and improve population health outcomes.
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I also gratefully acknowledge and thank the Health Research Council of New Zealand who granted me a PhD stipend to complete this thesis.

Finally, I wish to thank the children, parents, and schools who participated in the Kids’Cam study. Thank you for letting us into your lives and showing us your worlds.
Statement of Participation

This thesis was conducted as part of Kids’Cam, a study funded by a Health Research Council of New Zealand (programme grant #13/724). The primary aim of Kids’Cam was to quantify the nature and extent of children’s exposure to food and non-alcoholic beverage marketing in their everyday environments, using wearable cameras. Kids’Cam included 168 randomly selected Year 8 children from 16 randomly selected schools across the Wellington region. Kids’Cam was one of five studies that formed the Dietary Interventions: Evidence and Translation (DIET) programme, a five-year programme of research focused on informing national and international policies on the most effective and cost-efficient ways to improve population diets and health. DIET was a collaborative research programme led by Professor Cliona Ni Mhurchu (CNM) at the National Institute for Health Innovation (NIHI) at the University of Auckland with collaborators at the University of Otago, Wellington, and The George Institute for Global Health and the University of Oxford. Further information about DIET can be found at https://diet.auckland.ac.nz/.

The Kids’Cam research team

Kids’Cam was led by Associate Professor Louise Signal (LS), at the University of Otago, Wellington. Oversight for the Kids’Cam study was provided by CNM and the DIET Programme Advisory Group. The DIET Programme Advisory Group (PAG) provided expert advice to CNM and the research teams on priorities for policy and research. The PAG consisted of Māori and Pacific health experts, and those with expertise in marketing, food policy, food standards, advocacy and health promotion. PAG members included Megan Tunks (Toi Tangata), Christina McKerchar (University of Otago, Christchurch), Dave Munro (Heart Foundation), Dean Stockwell (Food Standards Australia and New Zealand), Elizabeth Aitken (Ministry of Health), Dr Gerhard Sundborn (University of Auckland), Dr Jenny Reid (Ministry for Primary Industries), Dr Mary-Ann Carter (Health Promotion
Agency), Nick Reilly (Auckland UniServices Ltd), and Dr Robin Toomath (Auckland District Health Board).

The Kids’Cam research team consisted of Dr Moira Smith (MS), Dr James Stanley (JS), Dr Gabrielle Jenkin (GJ), Tolotea Lanumata (TL), Tim Chambers (TC), Christina McKerchar (CM), Dr Amber Pearson (AP), Janet Hoek (JH), Dr Cathal Gurrin (CG), Professor Alan Smeaton (AS), Dr Zhengwei Qiu (ZQ), Dr Jiang Zhou (JZ), Aaron Duane (AD), and Michelle Barr (MB). Māori oversight for Kids’Cam was provided by Toi Tangata, as part of the DIET Advisory Group and by Christina McKerchar (Ngāti Kahanunu, Tūhoe and Ngāti Porou descent).

In addition to the collaboration with NIHI, Kids’Cam was also a collaboration with researchers at the Insight Centre for Data Analytics at Dublin City University (DCU). The team from DCU included AS, CG, ZQ, JZ and AD. These researchers developed a software browser that was used on our laptops, in the field, to review the wearable camera images and upload the images to the Kids’Cam server computer. The team at DCU also developed coding software that enabled us to add annotations (codes) directly to the images. Further, they worked with JS (Kids’Cam biostatistician) to develop the back end of the software to translate the image codes into numerical data for statistical analysis.

**My role in Kids’Cam**

I was a named investigator on the Kids’Cam study and received an HRC stipend to conduct my PhD as part of Kids'Cam. Below is a summary of my participation in the Kids’Cam study.

**Study set up**

I had a role in conceiving the Kids’Cam project alongside Professor Cliona Ni Mhurchu, Associate Professor Louise Signal (Principal Investigator), Dr Moira Smith, and Dr James Stanley. I undertook the feasibility study for Kids’Cam in
2012 for my Master's dissertation (Barr et al., 2013; Barr et al., 2015) I had a central role in developing the methods of data collection.

**Ethics approval**
Alongside LS and MS, I had a substantial role in developing the Kids’Cam application for ethical approval including the development of the information and consent forms for schools, parents, and children, as well as the discussion of potential problems in the study and the development of protocols to address these. Further, I developed the protocols for briefing children on the ethical and privacy issues associated with using wearable cameras.

**Pilot study**
I led the Kids’Cam pilot study and evaluation. The pilot study was conducted with ten children at one school; each child wore an Autographer and GPS device and participated in focus group interviews. I led the data collection for the pilot study and conducted one of the two focus groups with the children. I conducted an evaluation of the pilot study and assisted with changes to the study protocols. I also developed the Kids’Cam risk management strategy.

**Data collection**
Alongside, LS and MS I developed the Kids’Cam data collection and data management protocol documents. This including the protocols for recruiting schools and participants, and the protocols for each stage of data collection, including the invitation, briefing and review sessions. I also developed the participant information cards and project instruction booklet for participants.

In total, I was involved in 14 of the 25 data collection cycles. I led data collection in 8 schools over 9 data collection cycles, and I assisted in a further five collection cycles. During data collection, I also conducted 4 of the 33 interviews for the Kids’Cam qualitative study component.
**Image coding**

I led the development of the Kids’Cam annotation frameworks and had a substantial role in testing and refining annotation framework, as well as the production of test data sets for inter-coder reliability. I contributed substantially to the development of the coding rules and coding protocol document. Along with TC, I was a gold standard image coder for the Kids’Cam project.

I led the development of the nutrient profiling methods used in Kids’Cam. This involved the analysis of 5094 individual products from 200 common New Zealand grocery brands and 15 fast food chains. I also developed brand and product glossary documents for all annotators to aid them in their classification of food marketing. In addition, I manually coded the data from 156 days from 140 children. This included 140 Fridays before and after school, 6 full Saturdays, and 10 Thursdays before and after school.

**Data Analysis**

JS conducted the statistical analyses plan for the Kids’Cam study. To maximize the comparability of my results and those from Kids’Cam, I used the analysis plan developed by JS to analyse the data for this thesis. I performed the analysis with oversight provided by JS.

Detailed accounts of my contributions to the Kids’Cam study are provided in the relevant sections of Chapters Four and Five.
Publications arising from this thesis

Peer reviewed journal articles


**Conference presentations**


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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tbody>
<tr>
<td>ACT</td>
<td>Australian Capital Territory</td>
</tr>
<tr>
<td>ASA</td>
<td>Advertising Standards Association</td>
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<tr>
<td>BMI</td>
<td>Body mass index</td>
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<tr>
<td>DCU</td>
<td>Dublin City University</td>
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<tr>
<td>DIET</td>
<td>Dietary Interventions: Evidence and Translation programme</td>
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<td>ECHO</td>
<td>WHO Commission on Ending Childhood Obesity</td>
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<tr>
<td>EDNP</td>
<td>Energy-dense, nutrient-poor</td>
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<tr>
<td>EEP</td>
<td>Equal Explanatory Power</td>
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<tr>
<td>FBCS</td>
<td>Food and Beverage Classification System</td>
</tr>
<tr>
<td>FSANZ</td>
<td>Food Standards Australia and New Zealand</td>
</tr>
<tr>
<td>GPS</td>
<td>Global Positioning System</td>
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<tr>
<td>HFSS</td>
<td>High fat, salt, and sugar</td>
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<tr>
<td>HRC</td>
<td>The New Zealand Health Research Council</td>
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<tr>
<td>HSRS</td>
<td>Health Star Rating System</td>
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<tr>
<td>IOTF</td>
<td>International Obesity Task Force</td>
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<tr>
<td>NCD</td>
<td>Non-communicable disease</td>
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<td>NPM</td>
<td>Nutrient profiling model</td>
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<td>NZ</td>
<td>New Zealand</td>
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<tr>
<td>NZDep</td>
<td>The New Zealand Deprivation Index, a non-occupational, area-based measure of socioeconomic deprivation</td>
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<tr>
<td>NZiDep</td>
<td>The New Zealand Index of Deprivation for Individuals, a non-</td>
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occupational measure of individual socio-economic deprivation

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<tr>
<th>Acronym</th>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>PAG</td>
<td>Programme Advisory Group</td>
<td>Pan American Health Organization</td>
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<tr>
<td>PKM</td>
<td>Persuasion Knowledge Model</td>
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<tr>
<td>RR</td>
<td>Rate ratio</td>
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<tr>
<td>SSB</td>
<td>Sugar-sweetened beverage</td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>The United Kingdom</td>
<td></td>
</tr>
<tr>
<td>UKFSA</td>
<td>United Kingdom Food Standards Agency</td>
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<tr>
<td>UNCROC</td>
<td>United Nations Convention on the Rights of the Child</td>
<td></td>
</tr>
<tr>
<td>US</td>
<td>The United States of America</td>
<td></td>
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<tr>
<td>WHA</td>
<td>World Health Assembly</td>
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<tr>
<td>WHO</td>
<td>World Health Organization</td>
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<tr>
<td>WHO NPM</td>
<td>World Health Organization Regional Office for Europe Nutrient Profiling Model</td>
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<tr>
<td>95%CI</td>
<td>95% Confidence interval</td>
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Chapter One: Introduction

Obesity poses one of the greatest threats to public health in the twenty-first century. It is a leading cause of preventable disease (Ng et al., 2014; Swinburn et al., 2011). In 2010, excess adiposity was directly responsible for 3.4 million deaths and the loss of 93.6 million disability-adjusted life years, globally (Lim et al., 2013; Ng et al., 2014). The increasing prevalence of childhood obesity has also reached pandemic levels (Ng et al., 2014). Between 1980 and 2013 the worldwide prevalence of childhood overweight and obesity rose by 47.1% (Ng et al., 2014). This unparalleled rise in childhood obesity is concerning due to the appearance of non-communicable diseases (NCDs) in the child population and the subsequent increases in morbidity and mortality associated with obesity at a young age (World Health Organization, 2015a).

Obesity is an established risk factor for type 2 diabetes, cardiovascular disease, certain cancers, musculoskeletal disorders, and poor mental health (Doak et al., 2006; Han et al., 2010). The early onset of such conditions has lifetime consequences for the health, well-being, and productivity of obese children as they are more likely to experience the advanced complications of these conditions in earlier adulthood (Lobstein et al., 2004). Further, the rising tide of childhood obesity places a substantial future burden on the health system and economy (Lobstein et al., 2015). Although the rise in obesity is beginning to slow in developed countries, to date, no country has been successful in reducing the prevalence of obesity (Ng et al., 2014). Further, obesity is becoming increasingly prevalent in developing countries (Ng et al., 2014).

Childhood obesity is a significant concern in New Zealand. In 2016, 36.3% of New Zealand children aged 5 -17 years were either overweight or obese (Ministry of Health, 2016), the third highest rate of childhood obesity in the OECD after Italy and Greece (Organization for Economic Co-operation and Development, 2014). Further, there are large and enduring disparities in obesity prevalence among
Māori and Pacific children, who disproportionately bear the burden of childhood obesity and its adverse health consequences (Ministry of Health, 2016).

The causes of the childhood obesity epidemic have been widely debated with genetic, behavioural, environmental, and microbial explanations all proposed (Egger & Swinburn, 1997; Hu, 2003; Ley, 2010; Locke et al., 2015; Ramachandrappa & Farooqi, 2011). Fundamentally, obesity results from the sustained consumption of dietary energy in excess of that required to support daily activities and physiological processes (Egger & Swinburn, 1997). However, “obesity has occurred in the face of increasing knowledge, awareness and education about obesity, nutrition, and exercise. (Egger & Swinburn, 1997. p. 477).” Although individuals ultimately decide which foods and beverages to consume and the extent to which they engage in physical activities, many environmental factors including the food and built environments influence these choices (Egger & Swinburn, 1997).

The increased availability of cheap, highly palatable, energy-dense nutrient-poor foods coupled with the aggressive and pervasive marketing of these products to consumers are key drivers of the obesity epidemic (Ebbeling et al., 2002; Hill, 2006; James, 2008; Sallis & Glanz, 2009; Swinburn et al., 2011). Further, changes to the food environment have occurred in parallel with significant reductions in daily energy expenditure (Hill, 2006; Sallis & Glanz, 2009; Swinburn et al., 2011). Reductions in daily physical activity have been attributed to reduced occupational energy expenditure owing to increased mechanisation, increased reliance on motorised transport and more sedentary leisure activities, particularly screen use and television viewing (Church et al., 2011; James, 2008; Vandevijvere et al., 2015). Although an important contributor, the role of declining physical activity is thought to be less important than the role of the food system, of which food marketing is a part (Duffey & Popkin, 2011; Hill & Wyatt, 2005; Larson et al., 2009; Powell et al., 2007; Sallis & Glanz, 2006; Vandevijvere et al., 2015).
Although the origins of obesity are multifaceted, the pervasive marketing of energy-dense, nutrient-poor food is a significant contributor to the obesity epidemic (Cairns et al., 2013; World Health Organization, 2004; World Health Organization, 2010; World Health Organization, 2012b; World Health Organization, 2013; World Health Organization, 2016). Food marketing contributes to the development of obesity by influencing children's food and beverage preferences, purchases, consumption patterns and their nutritional knowledge (Cairns et al., 2013).

The contribution of food and beverage marketing to childhood overweight and obesity has been extensively researched over the past 30 years. In 2004, the 57th World Health Assembly (WHA) endorsed recommendations to restrict food marketing to children, as part of a wider strategy to combat growing rates of obesity (Global Strategy on Diet, Physical Activity, and Health) (World Health Organization, 2004). Following this, the World Health Organization (WHO) commissioned three systematic reviews into the extent, nature and impact of food promotion to children (Cairns et al., 2009; Cairns et al., 2013; Hastings et al., 2006). Ongoing research has consistently established that food marketing has a detrimental impact on children's dietary patterns and their diet-related health (Cairns et al., 2009; Cairns et al., 2013; Hastings et al., 2006; Hastings et al., 2003).

The World Health Organization has called for global action by member states to reduce the impact of food and beverage marketing to children and to implement the set of 12 policy recommendations developed in 2010 (World Health Organization, 2010; World Health Organization, 2013; World Health Organization, 2016). Further, in its final report, the Commission on Ending Childhood Obesity stated that “there is unequivocal evidence that the marketing of unhealthy foods and non-alcoholic beverages is related to childhood obesity” (World Health Organization, 2016, p. 18). Recommendation 1.3 in the report states that “settings where children and adolescents gather (such as schools and sports facilities or events) and the screen-based offerings they watch or participate in, should be free
of marketing of unhealthy foods and sugar-sweetened beverages” (World Health Organization, 2016, p. 18). In 2017, the World Health Organization released the Report of the Commission on Ending Childhood Obesity implementation plan. The Seventieth World Health Assembly endorsed the implementation plan which recommends that member states “adopt and implement effective measures, such as legislation or regulation, to restrict the marketing of food and non-alcoholic beverages to children and thereby reduce the exposure of children and adolescents to such marketing (World Health Organization, 2017, p.10).”

Despite these calls for action, member states have overwhelmingly failed to implement policy recommendations to restrict food marketing to children (World Health Organization, 2016). Calls for marketing restrictions continue to be met with strong opposition from the food industry (Hoek & Gendall, 2006). The food industry argues that regulation is unnecessary as a causal relationship between food marketing exposure and the development of obesity has not yet been established (Hoek & Gendall, 2006). They have responded to the threat of government regulation by developing voluntary codes for restricting food marketing to children (Hoek & Gendall, 2006). However, evidence suggests that these measures have been widely unsuccessful and children’s exposure to food advertising has not reduced with the introduction of voluntary codes (Adams et al., 2012; Galbraith-Emami & Lobstein, 2013). Despite overwhelming evidence of the harmful effects of food marketing to children, the situation remains largely unchanged, and governments remain reluctant to introduce statutory measures to regulate food marketing (Swinburn et al., 2015).

Although a large and comprehensive body of evidence exists on food marketing to children, the majority of this research provides accounts of the nature and extent of food marketing via single media (Halford & Boyland, 2013). Of this research, studies on television food advertising have been the most numerous, but other avenues of food marketing to children are amongst the growing body of evidence, including marketing in magazines; packaging; mail outs; billboards; ‘in school’
marketing, sports sponsorship and marketing via the internet and smartphones (Cairns et al., 2013; Vandevijvere et al., 2017). While together this research provides a picture of the ubiquitous presence of food marketing in children’s environments, children’s actual exposure to the full range of food marketing across all media and in multiple settings remains unknown (Halford & Boyland, 2013). Further, there has been little research on children’s exposure to food advertising in the outdoor environment (Pasch & Poulos, 2013). Although outdoor food advertising surrounding schools has been investigated previously, (Kelly, Cretikos, et al., 2008; Maher et al., 2005; Walton et al., 2009) little is known about the extent of children’s exposure to this, and food and beverage advertising in the wider community in which children live.

As a nutritionist, my research interests lie largely in exploring aspects of the environment that are likely to be actively driving the obesity epidemic and the corresponding increase in nutrition-related chronic diseases. In training to become a nutritionist, I was repeatedly faced with the idea that a healthy diet, and by extension a healthy body size, was accessible for all groups in society; it simply requires more responsible food choices on behalf of the individual. As I progressed through my undergraduate studies, it became apparent that there are many barriers to the consumption of a health-promoting diet for New Zealanders. These include physical barriers to accessing healthy food, economic barriers regarding food costs, and social norms created through the pervasive marketing of unhealthy foods over their more nutritious counterparts. It was also clear that educational interventions alone would not be sufficient to mitigate the impact of these external influences on population nutrition. It was my affinity for an ecological approach to obesity prevention which led me to complete a Master of Public Health, at the University of Otago, Wellington, conferred in 2013 (Barr et al., 2013; Barr et al., 2015).

When planning my Master’s dissertation, I was given the opportunity to pilot a novel method of documenting food marketing in children’s environments. Under
the supervision of Associate Professor Louise Signal and Dr Moira Smith, I conducted a pilot study, in Wellington, to determine the feasibility of using wearable cameras to capture children’s exposure to food and beverage marketing across the spectrum of their everyday environments. Findings from this feasibility study were used to support a Health Research Council grant application that was ultimately successful, providing funding for the Kids’ Cam study (of which my thesis is a part) and also my PhD stipend. This thesis builds on my Master’s dissertation and aims to determine the extent and nature of children’s exposure to outdoor food and non-alcoholic beverage advertising (hereafter food advertising). A cross-sectional observational study design was employed to answer the following central research question:

What is the extent and nature of children’s exposure to outdoor food and beverage advertising?

And the following sub research questions:

1. What is the extent and nature of children’s exposure to non-core and core outdoor food advertising?
   a) How does this vary by ethnicity, school decile, BMI category, and gender?
2. What is the extent and nature of children’s exposure to non-core and core outdoor food advertising on their journeys to and from school?
   a) How does this vary by ethnicity, school decile, BMI category, and gender?
3. What are the most frequently advertised non-core food product categories that children are exposed to:
   a) In all outdoor settings, and
   b) On the journey to and from school?

This research was conducted in the Wellington region of New Zealand.
Thesis outline

This chapter has outlined the purpose of my thesis and my approach to this research.

Chapter Two discusses childhood obesity and the contribution of food marketing to the obesity epidemic. The current trends in the prevalence of childhood obesity internationally and in New Zealand are examined. Ethnic and socioeconomic differences in obesity prevalence among New Zealand children are also discussed. An analysis of the health consequences and economic burden of childhood obesity follows. The remaining sections discuss the nature the foods marketed to children and their effects on children's consumption patterns, food preferences, purchasing behaviours and nutritional knowledge, using consumer socialisation theory, marketing's influence on children and how they develop cognitive defences to marketing are discussed. The chapter concludes with a brief overview of the different marketing mediums used to target children and places where children frequently encounter food marketing.

Chapter Three contains a narrative review of the literature on outdoor food advertising. This chapter explores the extent and nature of outdoor food advertising as well as its placement around schools, main streets and shopping areas. Using examples from the local and international literature, the evidence for a socioeconomic and ethnic difference in outdoor advertising exposure is also discussed. Methods of measuring outdoor food advertising and children's exposure to it are then reviewed with strengths and limitations of previously used methods considered. The need for objective measures that capture children’s environments, from their perspectives is then discussed. A discussion of children's neighbourhoods and the places they gather follows. In considering children's experience of their neighbourhoods, alternative methods of measuring children's exposure to outdoor food advertising are then explored. In this chapter, worldwide actions and World Health Organization recommendations on the
restriction of food and non-alcoholic beverage marketing to children are reviewed. This is followed by a discussion of the regulatory environment for food marketing and outdoor advertising in New Zealand. Selected international examples of outdoor advertising restriction in major cities are then discussed.

Chapter Four outlines the development of the methodological approach employed to investigate the extent and nature of outdoor food advertising among a sample of Wellington children. Chapter Four contains details of how the methods for the Kids'Cam project were developed, piloted, evaluated and subsequently refined. This chapter also contains details of the feasibility study and a pilot study that were conducted to determine the ethical, legal and practical feasibility of using wearable cameras to assess children’s exposure to food marketing, before the Kids'Cam study. Further, the pilot study evaluation is outlined as are details of how the evaluation informed refinements in procedures and the development of a risk management strategy for the Kids'Cam project.

Chapter Five contains details of the methods used in the Kids'Cam project as well as the methods used to answer the research questions specific to this thesis. The chapter begins by outlining the study design and sampling strategies employed to recruit the schools and children who participated. The methods of data collection using wearable cameras and the data management processes are also outlined. A description of the methods used to analyse the image data follows. The development and application of the image coding schedule are discussed, followed by a discussion of the choice of nutrient profiling model to analyse the observed food advertising and application of the model. Details of the image coding process are also given. The chapter concludes by outlining the statistical analysis used to determine the number and type of outdoor food advertising exposures children encountered during the time they spent in outdoor settings and on the journey to and from school.

Chapter Six is the first results chapter. This chapter presents the overall results of children's exposure to food advertising in outdoor settings. The chapter begins
with a description of the demographic characteristics of the sample and a
description of the data, including the amount of data each participant collected
and the mean proportion of time participants spent in each outdoor setting. The
rates of non-core and core advertising exposure overall, by setting and food
product type are then presented for each demographic group. The results of the
Poisson regression analyses are then presented. In this section, the mean rates of
non-core and core outdoor food advertising exposure are presented alongside the
rate ratios comparing exposure rates between demographic groups. Results of the
adjusted regression models are also presented. The chapter concludes with a
summary of the main findings.

Chapter Seven presents the results of children’s outdoor food advertising exposure
on the journey to and from school. Chapter seven follows the same structure as
chapter six. A summary of the main findings from the school journeys analysis
concludes chapter seven.

Chapter Eight contains a discussion of the main findings, and the conclusions and
recommendations resulting from this thesis. The chapter begins with an overview
of the main findings and compares them to the existing literature on children’s
exposure to outdoor food advertising. A discussion of the strengths and
limitations of the research follows. The implications of the findings from this
research are then discussed, and recommendations for policy and practice are
given. The chapter closes with the conclusions I have drawn from conducting this
research.
Chapter Two: Obesity & Food Marketing Exposure

This chapter reports on current obesity trends and examines how food marketing impacts children's diet-related health, informed by an ecological model of health and existing evidence of the extent, nature and impact of food marketing to children. This chapter also provides a brief summary of the psychological literature on how food marketing influences children.

Obesity prevalence and trends

The increasing prevalence of overweight and obesity among adults and children has reached pandemic levels (Ng et al., 2014). Between 1980 and 2014 the number of overweight and obese individuals rose from 857 million to 2.1 billion worldwide (Ng et al., 2014). Globally, between 1975 and 2016 the number of girls (aged 5-19 years) with obesity increased from 5 million to 50 million. Similarly, the number of boys (aged 5-19 years) with obesity increased from 6 million to 74 million over the same time period. Obesity is a key contributor to the growing burden of non-communicable disease (NCDs), and there is a well-established relationship between increasing body weight and increasing morbidity and mortality (Ng et al., 2014).

Defining obesity

Obesity has been defined as “a state of increased body weight, more specifically adipose tissue, of sufficient magnitude to produce adverse health consequences” (Spiegelman et al. 2001 p. 531). In adult populations, overweight and obesity are commonly defined using body mass index (BMI) cut-off points. BMI is a crude but effective measure of identifying and monitoring the prevalence of underweight, overweight, and obesity at the population level (World Health Organization, 2000). Body mass index is a measure of weight-for-height, determined by dividing
weight (in kg) by the square of the height in meters (kg/m²) (World Health Organization, 2000). BMI cut-off points for overweight (≥25kg/m²) and obesity (≥30kg/m²) reflect an increased risk of comorbidities associated with excess adiposity, as body weight for height increases (World Health Organization, 2000). As displayed in Table 1 the risk of comorbidity increases with overweight, with increased risk of varying severity for obese individuals.

<table>
<thead>
<tr>
<th>Classification</th>
<th>BMI kg/m²</th>
<th>Risk of Comorbidity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Underweight</td>
<td>&lt;18.5</td>
<td>Low</td>
</tr>
<tr>
<td>Normal weight</td>
<td>18.5-24.99</td>
<td>Average</td>
</tr>
<tr>
<td>Overweight</td>
<td>25.0-29.99</td>
<td>Increased</td>
</tr>
<tr>
<td>Obese</td>
<td>≥30.0</td>
<td></td>
</tr>
<tr>
<td>Obese class I</td>
<td>30.0–34.99</td>
<td>Moderate</td>
</tr>
<tr>
<td>Obese class II</td>
<td>35.0-39.99</td>
<td>Severe</td>
</tr>
<tr>
<td>Obese Class III</td>
<td>≥40.0</td>
<td>Very Severe</td>
</tr>
</tbody>
</table>

Table 1 Adapted from World Health Organization (2000, p.9).

Defining children

Throughout this thesis children are defined according to the United Nations Convention on the Rights of the Child (UNCRC). Article 1 of the UNCRC defines a child as "every human being below the age of eighteen years" (United Nations General Assembly, 1989).

Defining childhood obesity

The use of adult BMI cut-offs for children is problematic due to children’s high growth rate and the corresponding fluctuations in BMI as they age and develop. As such, the use of age and sex-specific BMI cut-offs is necessary for describing body size in children and young people. Childhood obesity is typically defined in one of two ways: by using the International BMI cut-offs for children (age 2 – 18 years), developed by the International Obesity Taskforce (IOTF) or the World Health Organization Growth Reference Charts (children age 5-19 years) (Cole et al., 2000; de Onis et al., 2007). Both methods have been used extensively to document and
Worldwide increases in childhood overweight and obesity

Among children, the worldwide prevalence of overweight and obesity rose by 47.1% between 1980 and 2013 (Ng et al., 2014). In developed countries, the prevalence of obesity increased from 16.6% to 23.2% between 1980 and 2013 (Ng et al., 2014). Significant increases in the prevalence of overweight and obesity have also occurred in developing countries (Ng et al., 2014). Although the prevalence of childhood obesity is higher in developed countries, the number of children living with obesity is greater in developing countries (World Health Organization, 2015a). This rise in childhood obesity is a concern due to the increasing prevalence of NCDs in the child population and the subsequent increases in morbidity and mortality associated with overweight and obesity at a young age (World Health Organization, 2015a).

The prevalence of childhood obesity in New Zealand has risen rapidly over the past three decades. In 2007, a reported 8.3% of New Zealand children were obese, and 20.9% were overweight (Ministry of Health, 2008a). By 2016, 13.3% of New Zealand children aged 5 to 17 years were obese, while a further 23% were overweight, for their height and age. In New Zealand and internationally, the burden of childhood overweight and obesity is also strongly patterned by socioeconomic deprivation and ethnicity. Indigenous and ethnic minority groups experience a disproportionately higher prevalence of obesity compared to those in majority ethnic groups.

In New Zealand, there are large and persistent disparities in the prevalence of obesity among Māori (indigenous population), Pacific (mostly second generation
migrants from Pacific Islands), and New Zealand European children. Results of the most recent New Zealand Health Survey reported that 61.1% of Pacific and 43.8% of Māori children (aged 2 to 14 years) were either overweight or obese, compared with 26.7% of New Zealand European/Other children (Ministry of Health, 2016). Currently, 6.8% of New Zealand European children are obese compared to 14.7% of Māori and 29.8% of Pacific children (Ministry of Health, 2016). Comparing obesity rates between ethnic groups revealed that Pacific children were almost four times (RR 3.87) more likely to be obese than non-Pacific children, adjusted for age and sex (Ministry of Health, 2016). Further, Māori children were significantly (RR 1.59) more likely to be obese than non-Māori children (adjusted for age and sex) (Ministry of Health, 2016).

**Social patterning of obesity**

Childhood obesity is more prevalent among those living in the most socioeconomically deprived areas than those living in the least socioeconomically deprived areas (Ng et al., 2014). In 2016, 4.0% of New Zealand children living in NZDep2013 quintile 1 (areas of lowest socioeconomic deprivation) were obese compared with 20% of children in NZDep2013 quintile 5 (the most socioeconomically deprived areas) (Ministry of Health, 2016). Those living in the areas of highest socioeconomic deprivation were approximately three times (RR 3.02) more likely to be obese than those living in the least deprived areas (Ministry of Health, 2016). This was most pronounced for boys living in the most deprived areas who were 4.5 times (RR 4.51) more likely to be obese than those in the least deprived areas (Ministry of Health, 2016).

The prevalence of overweight among New Zealand children follows a similar socioeconomic pattern. In 2016, 16.4% of children aged 2-14 years living in the least deprived areas were overweight compared with 26.4% of children living in the most deprived areas (Ministry of Health, 2016). However, when comparing the rates of overweight among those living in the most and the least deprived
areas, these differences were not statistically significant (Ministry of Health, 2016).

Overall, childhood obesity is a growing socially patterned problem worldwide and in New Zealand. In New Zealand, the prevalence of obesity is disproportionately high among Māori and Pacific children, and those children living in the areas of greatest socioeconomic deprivation.

**Diet and obesity**

At an individual level, the consumption of an energy-dense nutrient-poor (EDNP) diet in combination with increasingly sedentary jobs and leisure activities has been implicated as the primary cause of obesity (Swinburn et al., 2004). Over time, obesity develops as a result of the habitual consumption of an energy-dense diet that is high in fat, free sugars, and low in dietary fibre (Mendoza et al., 2007; Miller et al., 1994; Te Morenga et al., 2013). Evidence also demonstrates that specific dietary behaviours increase the risk of obesity and the consequent poor health outcomes. High intakes of fast food and sugar-sweetened beverages (including juices and energy drinks) are key contributors to the consumption of excess calories (Te Morenga et al., 2013). Further, skipping breakfast and eating a greater number of meals away from home are also associated with the consumption of a poor quality diet and higher BMI (Berg et al., 2009; Ma et al., 2003). In addition, reduced physical activity levels and increased time spent in sedentary behaviours, particularly time spent watching television, has been associated with a considerably higher risk of obesity (Dunstan et al., 2010; Hu, 2003).

Changes in body weight and adiposity occur when there is a sustained disruption in energy balance (Spiegelman & Flier, 2001). As depicted in Figure 1, the two key mediators of energy balance are dietary energy intake, and energy expenditure through physical activity. For example, weight gain and obesity develop when positive energy balance is sustained, that is, when energy intake consistently
exceeds energy expenditure (Spiegelman & Flier, 2001). Although energy intake and energy expenditure appear to be within the control of the individual, dietary and physical activity behaviours occur in the context of an individual’s environment (Egger & Swinburn, 1997). To conceptualise the environmental drivers of individual behaviours, Egger & Swinburn proposed the use of an ecological model (stylised in Figure 1) to explain the way environmental factors influence individual behaviour.

This model proposes that biological and environmental factors influence behaviours related to energy intake and expenditure (Egger & Swinburn, 1997). Biological factors are those that are unmodifiable but influence body weight, including age, sex, hormone levels and genetics (Egger & Swinburn, 1997). Although genetics are known to influence the storage and distribution of adipose tissue, a purely genetic explanation for the current obesity pandemic has been refuted (Walley et al., 2009). In Figure 1, physiological adjustment refers to the metabolic changes that occur in response to changes in energy balance (Egger & Swinburn, 1997). For example, when weight loss occurs, appetite may be stimulated, while physical activity may be reduced (Egger & Swinburn, 1997). Prolonged negative energy balance may result in a decline in basal metabolic rate and fat oxidation to conserve energy stores (Egger & Swinburn, 1997). However, to maximise storage of excess energy in adipose tissue for use in periods of famine or reduced food availability, responses to increased adiposity are less tightly controlled (Spiegelman & Flier, 2001).
Health consequences of childhood obesity

Elevated BMI during childhood and adolescence is a concern due to the associated increased risk of early-onset chronic diseases and future disease risk (Lobstein et al., 2004). The physical complications of severe childhood obesity are numerous and include hypertension, insulin resistance and type 2 diabetes mellitus, hypercholesterolemia and dyslipidemia, non-alcoholic fatty liver disease, earlier age of menarche in girls, sleep apnoea, asthma, and orthopedic complications (Han et al., 2010). The early onset of these conditions has lifetime consequences for the health, well-being, and productivity of the obese child, as they are more likely to experience the advanced complications of these conditions in earlier adulthood (Lobstein et al., 2004).

Long-term health outcomes

Childhood overweight and obesity are associated with significantly increased morbidity and premature mortality in later life (Reilly & Kelly, 2011). The long-term health risks of childhood overweight and obesity are related to the sustained disruption to metabolic systems over time (Doak et al., 2006). The progression of obesity into adulthood significantly increases the risk of developing type 2
diabetes, hypertension, hyperlipidemia, coronary heart disease, stroke, and certain cancers (Biro & Wien, 2010; Doak et al., 2006; Reilly & Kelly, 2011; Wang et al., 2010).

Cardiovascular risk factors present during childhood increase the risk of chronic disease during adulthood (Franks et al., 2010). Obese children frequently experience hypertension, and dyslipidemia, that is, increased serum levels of low-density lipoprotein (LDL), low levels of high-density lipoprotein (HDL) cholesterol and elevated triglycerides (Juhola et al., 2011; Lobstein et al., 2004). Dyslipidemia during childhood accelerates the formation of atherosclerotic plaque in the arteries (Lobstein et al., 2004). Evidence also suggests that elevated LDL cholesterol and total serum triglyceride levels during childhood are predictive of adult levels (Juhola et al., 2011). Similarly, blood pressure tracks from childhood to adulthood, with childhood hypertension predictive of elevated systolic blood pressure during adulthood (Chen & Wang, 2008; Lee et al., 2014).

The cardiovascular risk factors associated with childhood overweight and obesity largely continue into adulthood due to the persistence of obesity (Freedman et al., 2001; Juhola et al., 2013; Juhola et al., 2011). However, there is some evidence to suggest that cardiovascular risk remains elevated in adults who were overweight or obese as a child but have attained a healthy weight in adulthood (Biro & Wien, 2010; Franks et al., 2010; Must & Strauss, 1999).

**Psychosocial consequences of childhood obesity**

Obesity also has consequences for children’s psychosocial health. There is strong evidence that obesity negatively impacts the quality-of-life and self-esteem in children and adolescents, with obese children reporting lower levels of self-esteem and self-confidence than those who are a healthy weight (Griffiths et al., 2010). Increased social isolation and feelings of depression are also reported more frequently by obese children than those of a healthy weight (Daniels, 2005; Doak et al., 2006; Han et al., 2010; Wardle & Cooke, 2005; Waters et al., 2011).
Further, clinical studies of obese patients have reported that children with obesity had higher levels of diagnosed depression compared to their healthy-weight peers (Griffiths et al., 2010).

Research also suggests that obese children are more likely to be victims of bullying than those of a healthy weight, and are also more likely to report greater body dissatisfaction (Griffiths et al., 2010; Wardle & Cooke, 2005). However, there is evidence to suggest that body dissatisfaction, mood, and depression may be mediated by the severity of obesity, gender, ethnicity and socioeconomic position (Wardle & Cooke, 2005). For example, in one study, Caucasian and Hispanic girls experienced greater dissatisfaction compared to members of other ethnic groups (Wardle & Cooke, 2005). Overall, the evidence suggests that obesity has a negative impact on the psychosocial health of children and adolescents.

**Economic consequences of obesity**

Childhood and adulthood obesity also has economic consequences for both the individual and society (Wang et al., 2011). There are direct costs associated with treating obesity-related diseases and indirect costs associated with productivity losses (Finkelstein et al., 2005). The direct economic costs of obesity in both children and adults relate to the health care costs associated with treating obesity-related disorders, including pharmaceuticals, emergency medical care, inpatient costs, increased physician visits and ongoing outpatient costs (Cawley, 2010). The indirect costs of adulthood obesity are those related to work absenteeism, reduced productivity, fewer disability-free life years, and premature death (Wang et al., 2011). Lower educational attainment and lower wages are also more commonly reported by obese individuals than their healthy-weight peers (John et al., 2012). For parents of obese children, the economic consequences include missed work days or reduced hours to care for their child and attend clinic visits, and the real cost of physician visits (John et al., 2012).
Obese individuals also accumulate higher health care costs than their leaner peers. Systematic reviews suggest that obese individuals had cumulative lifelong health care costs 30% higher than those of a healthy weight (Withrow & Alter, 2011). Similarly, Finkelstein et al. (2009) reported that obese individuals in the United States incur 80% higher spending on pharmaceuticals, accumulate 46% higher inpatient costs, and have increased outpatient and physician visit costs 27% higher than those of a healthy weight (Finkelstein et al., 2005).

Worldwide, obesity will continue to escalate national health care expenditure due to the increased resources needed to treat obesity-related chronic diseases, such as diabetes (Wang et al., 2011). In 2006, obesity cost the New Zealand economy an estimated $849 million dollars in healthcare expenditure and lost productivity (Lal et al., 2012). These costs equated to 4.4% of the total health care spending in 2006. Comparatively, in 1991, 2.5% of health expenditure was for the treatment of obesity-related disease. In 2006, the costs of treating diabetes and hypertension were the greatest contributors to overall health care spending associated with obesity, being 38% and 28% respectively. Premature death was also a large contributor to productivity loses in 2006, costing an estimated $145 million dollars (Lal et al., 2012).

In the coming decades, the projected health care costs associated with the treatment of obesity are expected to rise exponentially, despite evidence to suggest that the rise in childhood obesity is beginning to slow in some developed countries including those in north western Europe and high-income, English speaking countries in the Asia-Pacific regions (NCD Risk Factor Collaboration, 2017). A study of the projected costs in the United States and the UK estimated that over the next 20 years there would be a combined total of between 6 to 8.5 million incident cases of diabetes and between 5.6 to 7.3 million patients with cardiovascular disease (CVD) (Wang et al., 2011). Further, over half a million new cancers cases are expected to require treatment in both countries (Wang et al., 2011). Together, the increasing prevalence of these NCDs would correspond to a
$48.0 to $66.0 billion and $1.9 to $2.0 billion dollars per year increase in healthcare expenditure in the US and UK respectively (Wang et al., 2011).

**Ecological model of health**

In the context of an obesity pandemic, ecological models provide a useful framework for conceptualising the multiple and interacting factors that influence food choice, food intake, and physical activity levels (Mehtälä et al., 2014; Sallis et al., 2008). One such model is styled in Figure 2. At the individual level, personal behaviours are influenced by knowledge, attitudes, skills, and resources, while at the interpersonal level peer, social and family groups also exert influence through norms and customs (Sallis et al., 2008). Organisational practices and community and cultural practices also influence health behaviours. Importantly, the built environment and public policies (local, national, and global) also influence food, eating and behaviours at a distal level (Sallis et al., 2008).

![Ecological Model of Health](source)

*Figure 2 Ecological Model of Health*

Source: Mehtälä et al. (2014).
Historically, obesity prevention and weight loss strategies focused on behavioural change, primarily at the individual level, with some focus on the interpersonal, organisational and community levels. However, there has been a shift in focus to the outer spheres of influence with the assertion that people live in an obesogenic environment, one where “obesity is a normal physiological response to an abnormal environment” (Swinburn et al., 1999). For example, two recent interventions to reduce childhood obesity in Victoria, Australia have taken an ecological approach involving local government, community and child-serving organisations alongside parents and children (de Silva-Sanigorski et al., 2010; Millar et al., 2011; Sanigorski et al., 2008).

The Romp & Chomp programme was a community-based obesity prevention programme targeted to 12,000 children aged zero to five years within Geelong and Queenscliff, Victoria between 2004 and 2008 (de Silva-Sanigorski et al., 2010). The programme was designed, planned and implemented in partnership with local government and community organisations. The focus of this intervention was to increase the capacity of child-serving institutions including early childhood education centres to promote healthy eating and active play to achieve a healthy weight among children aged zero to five years. By taking an ecological approach, the community, organisations and parents were supported through structural and policy changes to promote healthy eating and physical activity (de Silva-Sanigorski et al., 2010). The programme resulted in a 3 to 5 fold reduction in the prevalence of overweight and obesity in children aged 2 and 3.5 years in the intervention group than the comparison group who were exposed only to subtle health promotion messages (de Silva-Sanigorski et al., 2010). An earlier intervention, also conducted in Victoria, Australia reported similar findings with children aged 4 to 12 years.

The Be Active Eat Well programme also focused on building capacity among the community to develop its own programme to improve healthy eating and physical activity (Sanigorski et al., 2008). The intervention was designed, planned and implemented with key community organisations and stakeholders (Sanigorski et
One of the main objectives was to develop action plans around governance and partnerships with local government and community organisations and resource allocation for the project (Sanigorski et al., 2008). The intervention aimed to reduce TV viewing, reduce intake of energy-dense snacks, increase fruit intake, increase active transport to and from school, and increase active play on the weekends and after school (Sanigorski et al., 2008). The intervention also included the development of small parent support groups and a programme to improve deep frying cooking practices within local food outlets (Sanigorski et al., 2008).

The Be Active Eat Well intervention was successful in promoting healthy weight gain among children, with those in the intervention group gaining less weight (−0.92 kg), and having lower waist circumference (−3.14 cm) than those in the comparison population group (Sanigorski et al., 2008). In evaluating the intervention, the authors report that using an ecological approach to build capacity at different levels within society produced an effective obesity-reducing intervention that was cost-effective, sustainable and equitable (Sanigorski et al., 2008).

Focusing on environmental influences on food choices and physical activity behaviours recognises that the prevalence of obesity has increased in parallel with unprecedented changes in the food and physical activity environments. Such changes include increases in food marketing and the availability of highly processed, highly palatable, inexpensive EDNP foods, alongside increases in labour saving devices and increased sedentary leisure time activities and a reduction in physical activity (Brownell et al., 2010).

The food system and local food environments are important determinants of dietary quality among the resident population and can have protective or adverse effects on BMI (Popkin et al., 2005; Spence et al., 2009). For example, the increase in available calories in the food supply is more than sufficient to explain the observed weight gain in the US population between the 1970s and early 2000s.
Further, a recent analysis of energy in the food supply of 69 countries reported that in 80% of countries, the increase in available energy in the food supply was sufficient to explain the observed increases in average body size (Vandevijvere et al., 2015).

Living in low socioeconomic neighbourhoods and areas where healthy food is not readily accessible, available, or affordable is associated with increased obesity risk (Cummins & Macintyre, 2006; Ford & Dzewaltowski, 2008). Types of retail food outlets and their densities within a neighbourhood may also influence dietary intakes and obesity risk among the neighbourhood residents. Although the presence of healthy food stores in the neighbourhood is a precursor for the adoption of healthy dietary patterns, they are not sufficient to improve dietary patterns in the resident population (Ford & Dzewaltowski, 2008). Evidence suggests that although physical access is an important determinant of dietary quality and therefore obesity risk, food pricing may also be a prohibitive factor.

Current food pricing structures also encourage the consumption of diets rich in processed foods as they are often more affordable than their more nutritious counterparts (Drewnowski & Specter, 2004). Price is one of the most influential factors in food purchasing decisions (Drewnowski, 2004; French, 2003; Glanz et al., 1998; Steenhuis et al., 2011). Low-cost energy-dense foods such as butter, oils and sugars provide greater energy at a lower cost than fruits, vegetables or lean meats (Drewnowski, 2004). As such, processed foods, beverages, ready meals, snacks, and fast food manufacturers use these low-cost products to increase palatability and shelf life of the product to maximise their profits (Drewnowski, 2004). The consumption of highly processed foods is positively reinforced by their convenience and palatability and may be seen as the best option for low-income consumers wishing to reduce their weekly food bill (Drewnowski & Specter, 2004).

Increasing portion sizes have also been implicated as a contributor to the obesity epidemic as they result in increased energy intakes at eating occasions (Piernas &
Portion sizes have increased markedly since the 1970s (Young & Nestle, 2002). Data from the US indicates that larger portions of pizza and other fast foods, sweet drinks, savoury snacks, baked goods and French fries, in particular, contribute to the increasing amount of energy consumed at meals (Nielsen & Popkin, 2003; Piernas & Popkin, 2011a; Young & Nestle, 2002).

The origins and drivers of childhood obesity are multifactorial. Given the systemic and environmental drivers of childhood obesity, individual-level approaches to weight control and reduction are unlikely to be effective at a population level in the absence of supportive food environments and systems. Obesity is a concerning and complex public health problem in New Zealand and internationally with dire consequences for health, health care costs, and productivity. An ecological approach to obesity causation provides a framework for conceptualising the influence of environmental factors on individual behaviour. Although many factors contribute to the childhood obesity epidemic, this thesis focuses on the contribution of food marketing as restricting food marketing to children is a cost-effective population-based approach to prevent childhood obesity and reduce harm from diet-related NCDs (World Health Organization, 2012b).

**Food marketing to children**

As discussed in Chapter One, food marketing is understood to contribute to childhood obesity by promoting a preference for EDNP foods, by acting as a powerful cue for food consumption and influencing children’s food preferences and consumption, and requests for products, (Cairns et al., 2013). Further, food marketing influences children’s knowledge of healthy and unhealthy food products (Cairns et al., 2013). This section discusses the nature and influence of food marketing to children.
**Marketing**

Marketing has been described as “the means by which firms attempt to inform, persuade, incite, and remind consumers – directly or indirectly- about the brands they sell” (Keller, 2001, p. 819). Kotler (1972) argues that marketing is a process that involves two or more social units (individuals, groups, communities or organisations) and that marketing involves a transaction wherein at least one of the social units (the marketer) is seeking a specific response from another concerning a social object (e.g. a product or service). There are many elements and influences on the market response that marketers must take into account when developing their communications and strategies (McCarthy, 1960; Van Waterschoot & Van den Bulte, 1992). The most widely used framework to describe these elements and influences is the marketing mix, first described by McCarthy (1960), that includes the 4 Ps of marketing, Product, Place, Promotion, Price. Product can be defined as “the satisfaction or use derived or expected from the purchase of the product” (McCarthy, 1960, p. 209). Place concerns the location, accessibility and convenience of a product or service (McCarthy, 1960). Promotion has been defined as “any method of informing, persuading or reminding consumers about the marketing mix of product, place and price” (McCarthy, 1960, p. 480). Price is the usual amount of money exchanged for something and many include non-monetary costs such as the time or effort involved with product acquisition (McCarthy, 1960). Although, each component of the marketing mix is an important contributor to the way in which individuals respond to marketing communications, this thesis primarily focuses on the influences of place, promotion, and product. In this thesis promotion is conceptualised as the outdoor mediums used to advertise food and beverage products, the products are the types of foods and drinks advertised, and place is the location of the outdoor food advertising.
The nature of food marketing to children

Internationally, an estimated 60 to 90% of foods and beverages marketed to children are high in fat, salt, and sugar (HFSS), and are inconsistent with national nutrition guidelines and recommendations (Cairns et al., 2009; Hastings et al., 2003). Further, fruit, vegetables, and core foods such as whole grain bread, rice, pasta and low-fat dairy are noticeably absent from the food marketing to which children are exposed (Hastings et al., 2003). The most frequently marketed foods to children belong to just five food categories: high sugar breakfast cereals; confectionery; savoury snacks; soft drinks and fast food (Cairns et al., 2013). Such foods are high in fat, salt, and sugar, and low in fibre and micronutrients (Cairns et al., 2013).

Food is marketed to children using a variety of media (discussed later in this chapter). However, the nutritional value of the marketed products appears to remain consistent across the different media. Internationally, an estimated 67% of food advertisements during children’s television viewing times are for HFSS foods (Kelly, Halford, et al., 2010). Similarly, in New Zealand, 70% of television food advertisements are for HFSS food products (Jenkin et al., 2009; Maher et al., 2005; Wilson et al., 2006). Research into the nature of food marketing on the internet reported similar findings, with over 60% of internet food advertisements being for HFSS foods (Kelly, Bochynska, et al., 2008). Moreover, New Zealand and Australian authors have reported that 70 to 80% of all advertisements on billboards and signage near schools are for foods or beverages that are inconsistent with national nutritional guidelines (Kelly, Cretikos, et al., 2008; Maher et al., 2005).

Effect on consumption

The majority of evidence for the effects of advertising on children’s consumption patterns comes from research into the effects of television advertising. Television food advertising reportedly influences children’s taste preferences, purchases and
purchase requests (Borzekowski & Robinson, 2001; Cairns et al., 2013; McGinnis et al., 2006). Television advertising also directly influences food consumption and food choice by acting as a powerful external cue for consumption (Boyland et al., 2016; Halford et al., 2008; Harris, Bargh, et al., 2009; Zimmerman & Shimoga, 2014). Evidence suggests that exposure to food advertisements that emphasise the sensory properties of highly palatable foods creates a desire for food by triggering hunger, and thoughts and feelings about food, even in individuals who are fully satiated (Harris, Bargh, et al., 2009).

Several studies have reported a direct increase in the total amount of food and in the amount of unhealthy snack food consumed following exposure to food advertisements (Buijzen et al., 2008; Harris, Bargh, et al., 2009; Zimmerman & Shimoga, 2014). Adults in one experimental US study consumed an average of 65 kcal more following exposure to food advertising than those exposed to non-food advertising (Zimmerman & Shimoga, 2014). They were also more likely to choose unhealthy snacks, selecting 28% more unhealthy snacks than those exposed to non-food advertising (Zimmerman & Shimoga, 2014). Similarly, a study involving 93 UK children (age 5 to 7 years) reported that those who were shown ten food advertisements before a cartoon programme consumed significantly more kilocalories from snacks than when shown ten non-food advertisements before the same cartoon programme (Halford et al., 2007). On average, children consumed between 97 and 112 kcal more after viewing the food advertisements, depending on their weight status (Halford et al., 2007). However, this study did not take into account children’s habitual television viewing patterns (Halford et al., 2007). Children’s underlying television viewing habits may influence their responsiveness to food advertisements and therefore the amount of food consumed while watching television (Halford et al., 2007). However, similar findings were also reported from a more recent US study that tested the effect on children’s (7 to 11 years) snack food consumption of food advertisements embedded into a children’s television programme (Harris, Bargh, et al., 2009). Children who were exposed to the cartoon programme containing four food
advertisements consumed 45% more crackers than those exposed to the cartoon with four non-food advertisements (Harris, Bargh, et al., 2009).

High levels of exposure to commercial television have also been associated with more frequent consumption of unhealthy foods and beverages than those with low levels of exposure to television advertising (Buijzen et al., 2008). Further, exposure to television food advertising increases desire for, and acceptability of, the advertised food products (Cairns et al., 2013). For this reason, television advertising remains the most effective medium through which brand recognition and loyalty are created and developed among young children (Cairns et al., 2009; Harris, Bargh, et al., 2009). However, emerging research into online food and beverage marketing to children suggests that internet marketing strategies may be as effective as television advertising in strengthening brand awareness and encouraging product purchases (Bellman et al., 2014; Boyland & Whalen, 2015).

Although there is high-quality evidence to suggest that television advertising directly affects children’s food intake, there is little available evidence of the direct effects of food marketing via other marketing media on children’s food intakes.

**Effect on preferences**

Systematic review evidence suggests that advertising influences children’s food preferences at both a brand and category level and promotes the preference for EDNP foods (Cairns et al., 2009). Further, exposure to food advertising increases liking for and acceptability of the advertised food products (Cairns et al., 2009). A randomised control trial demonstrated an immediate effect on the food preferences of preschool children following exposure to food advertisements embedded in a television programme (Borzekowski & Robinson, 2001). In that study, children who viewed the programme containing food advertisements were significantly more likely to indicate a preference for the advertised food product than those who did not view the advertisements (Borzekowski & Robinson, 2001). Another US trial investigated the effects of marketing and branding on preschool
children's taste preferences. Sixty-three children tasted five pairs of identical food and beverage products – one wrapped in McDonald's packaging and the other in plain packaging – and were asked to indicate their preference for each product (Robinson et al., 2007). In four out of five cases, children were significantly more likely to indicate a preference for food if it was wrapped in McDonald's packaging (Robinson et al., 2007). They even preferred the taste of milk and carrots if they were wrapped in McDonald's packaging (Robinson et al., 2007). As demonstrated by this research, product packaging is also a persuasive medium which influences children's food choices and preferences.

The use of licensed characters, celebrities, sportspeople, premium offers, and health and nutrition claims on product packaging has been demonstrated to be particularly influential among children (Dixon et al., 2014; Jenkin et al., 2014; Kotler et al., 2012; Lapierre et al., 2011; Roberto et al., 2010). For example, in an experimental study of 343 New York children aged 2-6 years, children were asked to choose between foods in a container bearing a well-known character (from Sesame Street) and those in a container bearing an unknown cartoon character (Kotler et al., 2012). When choosing between two foods in the same category (e.g. two different vegetable options), children were more likely to choose the food item in packaging with a licensed or well-known character than foods associated with an unknown character or no character at all (Kotler et al., 2012). In the second experiment by Kotler et al. (2012), when presented with the option of a sugary or salty snack and a healthier snack option, both being associated with a familiar character, children still preferentially chose the unhealthy snack option over the healthy option (Kotler et al., 2012). Previous studies support this finding, wherein the use of a licensed character increased children's taste preferences for a healthy option when two healthy options were in competition (Roberto et al., 2010). However, the effect was not sustained when compared with an EDNP option (Roberto et al., 2010).

In a similar study, children were asked to rate the taste of cereal from two different cereal boxes, one with popular licensed characters, and one without
(Lapierre et al., 2011). Children rated the taste of the cereal from the character box significantly higher than that from the box that did not display the licensed characters (Lapierre et al., 2011).

The effects of nutrient content claims, sports celebrity endorsements, and premium offers on children's perceptions of child-targeted EDNP foods have also been investigated (Dixon et al., 2014). Compared to control groups, children in the experimental group were more likely to choose EDNP foods that had a nutrient claim on the pack (for example, reduced salt, source of calcium). As well as influencing choice, nutrient claims also improved children's perceptions of the nutrient content of the product (Dixon et al., 2014). Product packaging that displayed a sports celebrity was effective in positively influencing food choice among boys but not among girls (Dixon et al., 2014).

**Purchasing and purchase requests**

Systematic reviews commissioned by the UK Food Standards Agency (UKFSA), and subsequently the World Health Organization, concluded that there is strong evidence that food advertising and promotion influences children's food purchase related behaviour and purchase requests (Cairns et al., 2009; Hastings et al., 2006). For example, children who were more engaged with television advertisements during an experimental trial were observed to make a greater number of purchase requests when supermarket shopping with their parents (Galst & White, 1976). Children made an average of 15 attempts to influence purchase when at the supermarket, or one attempt for every two minutes that they were present in the store (Galst & White, 1976). The authors concluded that children who watched more commercial television made more purchase requests at the supermarket (Galst & White, 1976). In another study of children's influence on parental food purchasing, approximately half of the children reported suggesting to parents that they should purchase foods that they had seen advertised on television (Marquis, 2004).
Children's purchase requests are not limited to supermarket products. Data from the US suggests that children and adolescents have considerable influence over the choice of restaurant and fast food outlet when the family eats away from home, the types of foods purchased and prepared at home, and the brands of food product (Kraak & Pelletier, 1998). Products requested by children align with those that are heavily marketed to them including, sugar-sweetened breakfast cereals, confectionery, desserts, sweet drinks, snack foods and fast food (Kraak & Pelletier, 1998).

**Nutritional knowledge**

Food marketing can also influence children's nutritional knowledge and their understanding of what constitutes healthy food and a healthy diet (Cairns et al., 2013; Harrison, 2005). For example, children's exposure to and intensive viewing of food advertisements was associated with reduced accuracy in evaluating the nutritional value of artificial fruit products (Ross et al., 1982). Similarly, exposure to child-targeted food commercials, with their emphasis on fun and sensory properties of the food, have been reported to have negative effects on children's understanding of nutrition terminology and their nutrition knowledge (Wiman & Newman, 1989).

Food marketing may also undermine nutritional knowledge and reasoning. When presented with two foods items and asked to identify the more nutritious item, researchers found an association between television viewing and the incorrect identification of diet and low-fat options as more nutritious than a healthier item (Harrison, 2005). No differences were found by age or gender (Harrison, 2005). For example, incorrectly identifying low-fat ice-cream as the more nutritious item than cottage cheese (Harrison, 2005). Food advertising and promotion appear to have a negative effect on children’s nutrition knowledge.
Marketing mediums used to target children

There is a cumulative effect of advertising on reinforcing brand awareness, preferences and social norms (Keller, 2001). As such, marketers often use multiple media to impart their messages and reach the target audiences (Keller, 2001). There is a large body of literature that has investigated the extent of food advertising and promotion to children via different mediums including television, the internet, print media, product packaging, billboards and signage and sponsorship.

Television advertising

Television advertising is one of the first ways children will encounter food marketing and, despite a decline in recent years, it remains the principal medium through which food is marketed to children (Boyland & Whalen, 2015; Cairns et al., 2013). Although internet use among children is increasing rapidly, watching television is still the most popular media-based activity for children. For example, in the UK children (age 5-15 years) watch an average of 14.6 hours of television per week (Boyland & Whalen, 2015). Similarly, New Zealand children still engage with television more than any other media source, with 88% of children aged 6-14 watching television every day, while 66% of children in the same age group use the internet on a daily basis (Broadcast Standards Authority, 2015).

The extent of food advertisements during children’s television programming has been well documented (Cairns et al., 2009; Cairns et al., 2013; Harris, Bargh, et al., 2009; Hastings et al., 2003; Kelly, Halford, et al., 2010; Kelly et al., 2007; Wilson et al., 2006). A study of television advertising in 11 countries, reported that children see an average of three advertisements for unhealthy foods per channel, per hour (Kelly, Halford, et al., 2010). During the most popular children’s programmes, such advertising increased to four advertisements per channel per hour (Kelly, Halford, et al., 2010; Kelly et al., 2007). Assuming two hours of television viewing per day, children in these countries would be exposed to between 28-84 advertisements for unhealthy food weekly, with a median
exposure of 56 unhealthy advertisements per week (Kelly, Halford, et al., 2010). In an Australian study, the number of HFSS food advertisements increased during the highest rating television programmes from 3.5 to 9.0 advertisements per hour (Kelly et al., 2007).

New Zealand figures are similar to international reports. Reports indicate that 12.8 food advertisements are broadcast on the state-owned channel TV, and 6.3 on the commercially owned TV3 during the weekday afternoon time slot (3.30pm-6.30pm), of which approximately 70% were for HFSS foods (Wilson et al., 2006).

Although television advertising remains the dominant medium through which food is marketed to children, there is a growing body of evidence to suggest that new media, such as the internet, is playing an increasingly influential role in marketing food and non-alcoholic beverages to children.

**Online marketing**

Internet food marketing strategies are being increasingly employed to target children (Bellman et al., 2014; Cairns et al., 2013; Kelly, Bochynska, et al., 2008). The extent and plethora of different strategies used to market food to children via the internet is of significant concern due to their influence on children’s food preferences and impact on children’s dietary consumption patterns (Boyland & Whalen, 2015; Kelly, Bochynska, et al., 2008). Online advertising occurs through several different channels, including promotions on company-owned and third-party websites (not owned by the company), social media, email, and marketing via mobile devices through text messages, applications (apps), and branded games ‘advergames’ (advertising or brands incorporated into a game).

The interactive nature of these advertisements, particularly advergames, is designed to facilitate repeated and extended exposure to branding and food products. Repeated and extended advertising exposures build brand loyalty and influence children’s purchases and purchase requests (Cairns et al., 2009; Kelly, Bochynska, et al., 2008; Montgomery & Chester, 2009; Weber et al., 2006). The
introduction of Smartphones and related technology has substantially increased the amount of time children spend engaging with the internet and different forms of digital media (Montgomery & Chester, 2009).

The influence of online marketing on purchases, purchase requests and preferences at both the category and brand level are reportedly similar to those of television food advertising (Bellman et al., 2014; Cairns et al., 2009; Kelly, Bochynska, et al., 2008). However, evidence suggests that marketing via new forms of media may have a greater impact on children than traditional marketing mediums (Bellman et al., 2014; Kelly, Vandevijvere, et al., 2015). Children are less likely to recognise advertisements on web pages, particularly when the advertising is embedded within an online game or product website. As discussed above, cognitive recognition of the advertising is necessary to identify the persuasive intent of an advertisement. However, this embedded advertising is designed to promote a product but does not provide explicit advertising cues, such as those associated with commercial advertising breaks during television programmes (Kelly, Vandevijvere, et al., 2015).

The diversification of marketing mediums used to target children and young people online has kept pace with the rapid increase in the use of social media, such as Facebook, and the internet more widely (Kelly, Vandevijvere, et al., 2015). Food marketing through social media websites, such as Facebook, is reportedly highly effective in increasing brand awareness and encouraging product purchases due to peer endorsement of food products and brands and the ability to interact directly with food and beverage brands (Boyland & Whalen, 2015; Freeman et al., 2014; Kelly, Vandevijvere, et al., 2015). Almost two-thirds (66%) of New Zealand children (6-14 years) use the internet on a daily basis (Broadcast Standards Authority, 2015). Surveillance and monitoring of online activity and interactions with brands and peers through social media allow marketers to target and tailor advertisements to social media users based on their previous interactions with a brand to maximise marketing impact (Kelly, Vandevijvere, et
The use of these new media in conjunction with traditional media allows for the integration of marketing messages across multiple media platforms, increasing the reach of marketing messages (Kelly, Vandevijvere, et al., 2015).

**Product packaging**

Product packaging is a particularly salient marketing medium, as discussed above, as it is commonly used to attract attention, provide information about product attributes and to encourage purchase at the point-of-sale (Chapman et al., 2006). On-pack promotions including the use cartoon and movie characters, celebrity endorsements, colour, and typography, are all widely used to target children and their parents at the point of sale (Cairns et al., 2009; Chapman et al., 2006; Mehta et al., 2012). Further, photographs of the product, premiums and competitions, and nutrient and health claims are also widely used (Mehta et al., 2012).

Evidence suggests that promotions appear more frequently with product packaging for HFSS foods than on healthier food products (Mehta et al., 2012). An audit of the marketing techniques used to target children on product packaging within an Australian supermarket found that of the 157 products audited, 75% were EDNP foods (Mehta et al., 2012). Confectionery and chocolate, snack foods and healthy dairy products were the three food categories that had the most on-pack promotions (Mehta et al., 2012). Cartoons and celebrities appeared on 85% of products, while 99% used graphics and colours to target children (Mehta et al., 2012). Health or nutrient claims appeared on 64.0% of all products and also appeared on 55.5% of the HFSS foods identified in this study (Mehta et al., 2012). Such claims are used by marketers to portray unhealthy products in a more favourable light, creating confusion and potentially deceiving the consumer into thinking the product is more nutritious than it is (Hawkes, 2010; Mehta et al., 2012). Further, these claims are often used by children during purchase requests and negotiations to convince parents of the product’s nutrient value (Mehta et al., 2012).
Print media
Print media includes advertising and editorial content, gifts and promotions offered by the print media, and includes newspapers, flyers, and magazines (World Health Organization, 2012a). Similar to other mediums, food marketing in child-targeted print media is characterised by the promotion of HFSS foods. However, due to a scarcity of research on food marketing to children using print media, this section focuses primarily on the extent and nature of food marketing in children’s magazines.

The extent and nature of food references and marketing in children’s magazines have been investigated by multiple Australian authors (Jones et al., 2012; Jones & Reid, 2010; Kelly & Chapman, 2007). Using content analysis, researchers have analysed food references from between six and seventeen popular Australian children’s magazines over a 12 month period. Collectively, these studies report that between 63.7% and 86.2% of food references and branded food advertisements in magazines were for unhealthy (HFSS) food and beverage products (Jones et al., 2012; Kelly & Chapman, 2007). Promotions in magazines were largely for food products in the following categories: ice cream and iced confectionery, fast food restaurant meals, high-sugar drinks, chocolate and confectionery, and snack foods (Jones et al., 2012; Kelly & Chapman, 2007). Premiums, competitions, puzzles and games, and editorial content were the most common marketing techniques used in children’s magazines (Jones & Reid, 2010). As with other forms of food marketing, advertising in print media is primarily for HFSS foods and encourages the consumption of unhealthy foods over more nutritious alternatives.

Settings in which children encounter advertising
As discussed above, children frequently encounter food marketing via television advertisements, online marketing, magazines and product packaging. Many of
these exposures are likely to occur in the home environment. However, as children spend time in numerous different environments over the course of a typical day (Carroll, Witten, Kearns, et al., 2015), they also encounter food marketing in a number of different locations and settings including but not limited to school, sport and recreation facilities and in outdoor places.

**School**

The school environment provides a unique opportunity to promote health as children spend the majority of their waking hours at school (Regan et al., 2008). However, evidence suggests that school environments may promote the consumption of HFSS foods through the promotion, provision, and pricing of such foods (Carter & Swinburn, 2004; Story & French, 2004). Major corporate brands market their products, typically HFSS foods, in schools in exchange for sponsorship and other incentives (Richards et al., 2005). A nationally representative sample of New Zealand primary schools reported that 91% of the sampled schools raised funds through the sale of various products, of which 58% were HFSS foods (Richards et al., 2005). The presence of vending machines, offering soft drinks and snack foods, was also reported in numerous high schools (Richards et al., 2005). In 2008, the New Zealand government introduced a clause into the National Administrative Guidelines for schools which required that only healthy food and beverage options be available in schools (Utter et al., 2009). However, in 2009 the incoming government removed this clause. This is of particular concern as research suggests that the use of school canteens is associated with the more frequent consumption of HFSS foods among New Zealand school children (Utter et al., 2007). Further, research conducted in Canada reported that food and beverage logos, found in schools, and are positively associated with the purchase and consumption of HFSS foods in the school environment (Minaker et al., 2011). Overall, this research suggests that children may frequently be exposed to food marketing while at school.
**Sport and recreation**

Children also encounter food marketing, largely in the form of sports sponsorship, in sports and recreation facilities (Carter et al., 2012; Kelly et al., 2014). However, there has been little research into children’s exposure to food marketing in these settings. In one example, Kelly et al. (2014) calculated population estimates of Australian children’s exposure to food and beverage sponsorship at organised sport during games and practices. Reportedly, exposures to food and beverage sponsorship were highest among children who played outdoor soccer, cricket, rugby league, outdoor netball and athletics. For example, on a weekly basis, the 28,300 New South Wales children who played rugby league were collectively exposed to 63,700 person hours of food and beverage sponsorship (Kelly et al., 2014). Further, a systematic review of the availability and marketing of food and beverages available in sports settings reported that much of the food available is energy-dense, and nutrient poor (Carter et al., 2012). Although little is known about children’s exposure to food and beverage marketing in sports settings, research suggests that food and beverage sponsorship in sports settings is widespread at the community and elite sporting levels (Kelly, Baur, et al., 2010; Kelly, Baur, et al., 2011; Sherriff et al., 2010).

**Outdoor advertising**

Outdoor advertising is another potential source of children’s food marketing exposure as it is commonly used to promote food and beverage products (Pasch & Poulos, 2013). Outdoor advertising includes all promotions that occur in outdoor settings via billboards (including mobile billboards), signs (including printed, painted and digital signs), posters, sandwich boards, flags and banners (Upper Hutt City Council, 2017). Evidence suggests that outdoor food and beverage advertisements are commonly found on main streets, and are often concentrated heavily around schools, convenience stores, shopping complexes, and bus and train stations where they are likely to be repeatedly viewed by large numbers of people (Adams et al., 2011; Isgor et al., 2016; Kelly, Cretikos, et al., 2008; Kelly,
King, et al., 2015; Settle et al., 2014). Research conducted in the Asia Pacific region suggests that outdoor food advertising surround schools is predominantly for HFSS food and beverages, and may, therefore, have an adverse impact on children’s dietary choices and health (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005; Walton et al., 2009). As this thesis focuses on outdoor food and beverage advertising, the following chapter reviews the existing literature on the extent and nature of outdoor food advertising. Including the placement and clustering of outdoor advertising and differences in the extent and nature of outdoor advertising by neighbourhood demographic characteristics.

**Section summary**

Overall, the evidence suggests that up to 90% of foods marketed to children are high in fat, salt and sugar. Further, food marketing directly influences children’s food intake by acting as a cue for consumption and indirectly influences children’s consumption patterns by shaping their food preferences and purchases. Further, marketing encourages children to make purchase requests for those products that are frequently marketed to them. Food marketing influences children’s diet-related health by influencing their understanding of the nutritional value of foods and beverages. Historically, television advertising has been the dominant medium through which food is marketing to children. In recent years online marketing has begun to play an increasingly influential role in marketing food and beverages to children. Food and beverages are now marketed to children through multiple different media using integrated marketing strategies to extend the reach of marking messages. Further, food marketing is a pervasive feature in many of the places where children gather and spend time.

**Marketing to children**

Children are a lucrative target for food marketers as they have spending capital of their own, substantial influence over household spending on food and a lifetime as consumers ahead of them (Cairns et al., 2009; Hastings et al., 2003; Shaw, 2009).
Over time, marketers have developed diverse strategies to target children. The child market has become increasingly important since the 1970s and 1980s due to an exponential increase in children's economic power, in their own right as consumers, and also through their influence on household spending patterns (Valkenburg & Cantor, 2001).

The increase in child spending power and influence has been associated with increasing levels of parental education, higher incomes, longer work hours and more than one parent in the workforce (Valkenburg & Cantor, 2001). Further, children’s influence on household spending and parental decision-making is thought to have increased in recent years due to a shift in parenting approach in western countries (Valkenburg & Cantor, 2001). Negotiation and child involvement in decision making is now commonplace among families (Valkenburg & Cantor, 2001). As such, children exert significant influence over household purchases and patterns of spending (Valkenburg & Cantor, 2001). In the US, children aged between two and fourteen years influence an estimated $500 billion per year in household spending (Calvert, 2008). By the time children are ten years old, they make multiple purchases of their own on a weekly basis and frequently visit a variety of retail stores (Calvert, 2008). Research from the US revealed that children aged two to fourteen years spent a total of 30 billion dollars in 2002 (Calvert, 2008).

Children are also an important target for marketers due to their status as future consumers (Cairns et al., 2009; Valkenburg & Cantor, 2001). Brand loyalty is developed at a young age. As such, marketing is targeted to children to create and develop positive brand associations to encourage the regular and prolonged purchase of a brand or product (Valkenburg & Cantor, 2001). Brand loyalty and positive brand associations also persist into adulthood (Valkenburg & Cantor, 2001).

Branding is a crucial element in the marketing and promotion of all products, and it is particularly important in the marketing of food and beverage products to
children (Boyland & Halford, 2013). Food is one of the most highly branded goods on the market, with branding appearing on an estimated 80% of food items in U.S grocery stores (Boyland & Halford, 2013). Branding has been defined as “a name, term, sign, symbol, design or combination of these, that identifies the goods or services of one seller or group of sellers and differentiates them from those of the competition.” (Chang & Liu, 2009, p. 1688). It is an important feature used in advertisements to engage children and young people in developing brand awareness and brand loyalty at an early age (Story & French, 2004). From early childhood, the majority of children can recognise multiple brands, with the identification of brands and products transforming into purchase requests (Story & French, 2004).

Children's purchase requests are strongly associated with food products or brands that are heavily and continually marketed through multiple mediums, concurrently (Cornwell & McAlister, 2011; Mehta et al., 2012). The high level of branding associated with food and beverage products enables marketers and food manufacturers to promote these products via multiple media channels (Boyland & Halford, 2013).

**Appealing to children**

Numerous appeals are used in the promotion of foods to engage children and to encourage preferences, purchases and purchase requests (Cairns et al., 2009), as discussed earlier. These appeals typically emphasise taste, fun, fantasy and action adventure, novelty, humour, and nutrition or health properties (Cairns et al., 2009; Harris, Bargh, et al., 2009; Harris, Pomeranz, et al., 2009; Hastings et al., 2003; Jenkin et al., 2014; Mehta et al., 2012). Food advertisements also frequently depict positive outcomes from the consumption of unhealthy food or meals, such as happiness and social inclusion (Harris, Bargh, et al., 2009). Further, premiums, competitions and collectable items are all used by food manufacturers to encourage pester-power among children, to influence parents to purchase a
particular brand or product and to encourage repeat purchases (Cairns et al., 2009).

Overall, children are an important target market that have considerable spending power and influence, and who are also greatly swayed by food marketing.

**Consumer socialisation of children**

To conceptualise the influence of marketing on children’s consumer-related preferences, knowledge, attitudes and values, consumer socialisation theory provides a useful framework (Ward, 1974). Consumer socialisation is the process by which children develop the skills, knowledge, and attitudes to participate as consumers in the marketplace (Moschis & Churchill Jr, 1978). This theory uses the combination of cognitive development theory and social learning theory to explain the process by which children progressively develop consumer-related knowledge and skills (Moschis & Churchill Jr, 1978). Figure 3 outlines the complex mechanisms through which children acquire consumer-related skills. The process involves the interaction of the child’s stage of cognitive and social development, their socioeconomic position, gender, and culture with socialisation agents, of which parents, peers and mass media are the most influential (Moschis & Churchill Jr, 1978).

Theorists argue that consumer skills are learnt progressively over the course of childhood into early adulthood, with proficiency in consumer behaviours and knowledge corresponding with children’s advancing social and cognitive development (John, 1999). The three stages of socialisation – the perceptual stage (3-7 years), the analytical stage (7-11 years), and the reflective stage (11-16 years) – are characterised by changes in consumer-related knowledge structures, decision making, attitudes and motivations (John, 1999). The relative influence of the major socialisation agents changes with advancing age.
Perceptual stage

The perceptual stage of consumer socialisation typically describes the consumer learning between the ages of three and seven years (Moschis & Churchill Jr, 1978). This stage is characterised by a focus on the readily perceivable aspects of the consumer marketplace (John, 1999). During this stage children can recognise multiple brands and retail stores but typically only have a surface level understanding of brands and products, usually with a focus on one salient aspect of the brand or product. Similarly, consumer decisions are commonly made based on limited information or single attributes such as package size or colour. During this stage, children’s consumer knowledge is largely informed by their own observations or experiences and is characterised by limited adaptability and negotiation skills in attempts to influence parental purchase decisions. Children have limited or simplistic negotiation skills during the perceptual stage as they struggle to think about their perspective and that of another person simultaneously (John, 1999).

Analytical stage

The analytical stage of consumer socialisation occurs between the ages of seven and eleven years (Moschis & Churchill Jr, 1978). This period of cognitive and social development is characterised by improved information processing abilities and a shift from perceptual to abstract thinking (John, 1999). These changes allow
for a more complex understanding of the consumer marketplace and concepts such as advertising and branding. Children also develop a more complex understanding of product categories and the many purchasing possibilities within each category as well as an increasing awareness of the role of pricing (John, 1999).

As children’s thought becomes increasingly abstract, their consumer decisions become more complex than those made during the perceptual stage. During the analytical stage, children have an increased ability to analyse products based on multiple, not just surface level, attributes (such as size or colour). Children’s consumer decisions also become more flexible and responsive during this stage. For example, being able to select an appropriate replacement if their preferred brand or product is not in-stock. During this stage children develop the ability to think from another person’s perspective. Attempts to influence purchases or negotiate for preferred products become increasingly complex, reflecting this new found perspective. Children also develop an awareness of the purpose of advertising and advertiser motives during the analytical stage (John, 1999).

Reflective stage

The reflective stage (ages 11-16) is characterised by an increasing understanding of advertising and its persuasive intent, a diverse knowledge of products and brands, and a growing understanding of pricing and how the marketplace functions (Hota & McGuiggan, 2006; John, 1999; North & Kotzé, 2001). Children in the reflective stage also possess a new-found need to shape their identity and have an intensified awareness of other people’s points-of-view (Hota & McGuiggan, 2006; John, 1999). Conforming to social expectations and norms within peer groups is also paramount during this stage. There is an increased awareness of branding and the types of products consumed by others in their peer group and an increasing awareness of values behind consumer decisions and how their decisions will be evaluated by their peers (Hota & McGuiggan, 2006; John, 1999).
Socialisation agents

It has been argued that the three most influential socialisation agents are parents, peers and mass media (Moschis & Churchill Jr, 1978). The influence of each agent is discussed below.

Parents

Parents are the primary agents of consumer socialisation (North & Kotzé, 2001). During early life, parents are the most important and influential socialisation agents acting on children as they provide direct guidance about appropriate consumer behaviour, model consumer behaviours, and supervise and mediate children’s consumer activities (Hota & McGuiggan, 2006; Neeley, 2005). During the perceptual and analytical stages, parents and family members exert the greatest influence on children’s consumer behaviour (John, 1999). With advancing child age, parental influence on consumer learning diminishes with the increasing influence of peers which peaks during adolescence (reflective stage)(Dotson & Hyatt, 2005; Ward, 1974).

Peers

Children's peers are important socialisation agents, particularly during the reflective stage of consumer socialisation as they influence children’s preferences and the development of consumer values and attitudes. Children often communicate with their friends and peers about goods and services and their social importance (Moschis & Churchill Jr, 1978). This interaction can develop positive aspects of consumer behaviour including prompting children to seek out additional sources of information about a brand or product (usually from other socialisation agents) and increase children's awareness of advertising and help them develop cognitive defences against it (Hota & McGuiggan, 2006). Peer interactions also aid in building children's general consumer affairs knowledge providing details of new or alternative products within the marketplace and where or how to purchase these goods (Hota & McGuiggan, 2006; Moschis & Churchill Jr, 1978). However, peers can have a negative influence on children's
consumer socialisation as their influence can contribute to the development of materialistic attitudes and brand consciousness. Children will often consider peer preferences when evaluating products or brands (Hota & McGuiggan, 2006). Further, children in the reflective stage develop an increasing awareness of the values behind consumer decisions and how their decisions will be evaluated by their peers (Hota & McGuiggan, 2006; John, 1999).

As children age and move into the reflective stage of socialisation, the relative socialisation influence of parents reduces while that of peers increases. The increasing influence of peers is likely due to growing independence and a reduced number of daily interactions with parents and increasing amount of interpersonal communication with peers during this stage of development.

**Mass media**

Television and other mass media also play a significant role in children's consumer socialisation (Hota & McGuiggan, 2006; Moschis & Churchill Jr, 1978; Ward, 1974). Mass media have a demonstrated effect on product knowledge, brand recognition and preferences and purchasing behaviour and requests in children (Cairns et al., 2013; Churchill Jr & Moschis, 1979). Further, television and other media viewing has been associated with increased brand awareness and positively influences children’s views of advertisements (Dotson & Hyatt, 2005; Valkenburg & Buizen, 2005). Relative to the influence of parents and peers, television advertisements were thought to be less influential but were thought to provide a more consistent socialising influence throughout childhood (Dotson & Hyatt, 2005; Ward, 1974). However, more recent research suggests that the influence of mass media may be more pronounced in today's children owing to large increases in children's media use and increased media interaction from a younger age (Dotson & Hyatt, 2005; Dunlop et al., 2016; Kraak & Pelletier, 1998). As discussed earlier in this chapter, there is a large body of literature on food marketing to children that describes the effects of mass media on the development of children's food-related purchase behaviour, knowledge and
preferences. The following sections give a brief overview of the psychological literature examining how children process and respond to advertising exposure.

**Advertising’s influence on children**

Children are the population group most vulnerable to the persuasive effects of advertising (Kunkel et al., 2004). Children’s unique susceptibility to advertising is largely attributed to their cognitive immaturity and limited cognitive defences against advertising (John, 1999; Kunkel et al., 2004). Traditional explanations for the effects of advertising on children’s food preferences and consumption behaviours have focused on information processing, or cognitive development approaches, the latter of which is based on Piaget’s theory of cognitive development (John, 1999; McGuire, 1976). Both approaches assume that children’s responses to advertising follow logical, sequential pathways, and with increasing age cognitive defences are developed to reduce the influence of advertising (John, 1999; McGuire, 1976), as discussed above. In developing media literacy and cognitive defences, the two critical factors are the ability to differentiate between advertising and television programme content, and the recognition of advertising’s persuasive intent (Blatt et al., 1972; Harris, Brownell, et al., 2009; John, 1999; Kunkel et al., 2004; Livingstone & Helsper, 2006; Nairn & Fine, 2008). The age at which these cognitive defences develop has been widely disputed and is an important consideration in the development of advertising restrictions to children. The proposed ages for restriction of food marketing to children range from 12 to 18 years old, depending on the country (World Cancer Research Fund International, 2017).

Evidence suggests that children learn to distinguish advertising from television programme content at a young age (Levin et al., 1982). By the age of five years, most children can make this distinction (Levin et al., 1982). However, at this age children are not aware of the persuasive intent of advertising and instead typically view advertising as an information source or entertainment (John, 1999).
Children may develop an understanding of advertising’s selling intent by seven to eight years. However, their ability to detect and critique specific instances of deception or bias in advertisements continues to develop with age (John, 1999), as discussed earlier.

Some authors have argued that children begin to develop distrust towards advertisements and report less liking for advertising overall by the age of seven or eight years (Blatt et al., 1972; John, 1999). However, Carter et al. (2011) argue that the majority of children are aware of the selling intent of advertising by age eight but do not specifically recognise the persuasive intent at this age. In their experimental study of 594 children aged four to twelve years, the researchers assessed children’s understanding of advertising’s intent using a combination of small focus groups and a non-verbal pictorial response sheet (Carter et al., 2011). Of the children, 56% of seven to eight year-olds identified the selling intent of advertising. However, only 8% could identify the persuasive intent of advertising (Carter et al., 2011). That is, the majority of children at this age did not recognise the advertiser’s intent was to get them to purchase something that they otherwise may not have purchased (Carter et al., 2011).

Similar findings were reported in an earlier study by Oates et al. (2002) who reported that US children aged eight to ten years had a limited understanding of advertising’s purpose. When asked about the purpose of advertising, only 25% of eight year-olds and 36% of ten year-olds were able to recognise the persuasive intent of advertising (Oates et al., 2002). Further, 44% of children aged eight to ten years believed that the purpose of advertising was to provide information about available products (Oates et al., 2002). The remaining children believed that advertisements were there to provide a break in television programmes or as an entertainment source (Oates et al., 2002). Overall, the evidence suggests that it is unlikely that children are fully aware of the persuasive intent until later in adolescence, as consumer socialisation theory suggests.
As children move into the reflective stage of consumer socialisation (ages 11-16 years), their advertising literacy improves as their critical and independent thinking develops (John, 1999). Some authors argue that by the age of 12 years children have developed cognitive defences against advertising’s influence (Blatt et al., 1972; John, 1999; Rozendaal, Buijzen, et al., 2011). Such defences include a critical understanding of advertising and its persuasive intent, and the ability to critically evaluate advertising’s truthfulness and the advertiser’s motives (Blatt et al., 1972; John, 1999; Rozendaal, Buijzen, et al., 2011; Valkenburg & Cantor, 2001). However, a growing body of evidence suggests that children’s ability to critically evaluate advertising does not develop until later in adolescence, and continues to develop until early adulthood (Carter et al., 2011; Harris, Brownell, et al., 2009; Kunkel et al., 2004; Livingstone & Helsper, 2006; Nairn & Fine, 2008; Wright et al., 2005). Collectively, this evidence suggests that although the ability to differentiate advertising from programme content, understand the selling intent of advertising, and to recognise the persuasive nature of advertising are important components, these defences alone do not adequately protect children from the influence of advertising.

As an alternative model of understanding how children develop defences against advertising, Friestad & Wright (1994) propose the use of the persuasion knowledge model (PKM). The PKM describes the way individuals develop and use persuasion knowledge to cope with persuasion attempts from advertising and other external forces (Friestad & Wright, 1994). As with the age-stage model outlined by John (1999), the PKM recognises that a child’s persuasion knowledge is dependent on their stage of social and cognitive development, but also recognises that persuasion knowledge will continue to develop with advancing age and experience over a person’s lifetime (Friestad & Wright, 1994). Further, as with John (1999), the PKM assumes that children’s understanding of the persuasive nature of advertising is central to being able to defend against its influence.
The PKM can be used to explain how individuals develop persuasion knowledge, how this knowledge is used when faced with a persuasion attempt, and how changes in persuasion knowledge will determine the outcome of the persuasion attempt (Friestad & Wright, 1994). In 2005, Wright, Friestad and Boush used the PKM to describe the development of marketplace persuasion knowledge in children and young adults and how it is used to defend against advertising influence. In that paper, the authors argue that children develop practical expertise in coping with persuasion attempts by recognising, evaluating and responding to these attempts (Wright et al., 2005). Further, children’s ability to cope with persuasive attempts will be most advanced for those that occur through the advertising medium or technique that a child encounters most frequently (Wright et al., 2005). For example, if a child most frequently encounters persuasive attempts via television advertisements, their ability to cope with persuasion from this medium will be better developed than their ability to cope with an advertisement embedded in a computer game. To mount an effective cognitive defence against advertising, Wright et al. (2005) argue that children must be able to do the following:

- access advertising and persuasion knowledge from memory,
- recognise when a persuasion attempt is occurring, note features of advertising that indicate what the marketer’s specific tactics and goals are in the particular campaign or situation, construct or execute their own message-processing and persuasion coping tactics, and commit to memory information about the tactics used in specific advertisements and access that information in future to recognise similar ploys (Wright et al. 2005, p. 227).

However, accessing these cognitive defences automatically, at the time of advertising exposure is a learned skill and may not develop until late in adolescence (Harris, Brownell, et al., 2009; John, 1999; Wright et al., 2005).

Although advertising literacy increases children’s awareness of the selling and persuasive intent of advertisements, it does not appear to make children less susceptible to advertising’s effects on attitudes or preferences (Harris, Brownell, et al., 2009; Livingstone & Helsper, 2006; Nairn & Fine, 2008; Rozendaal, Lapierre,
et al., 2011). Therefore, these cognitive defences may have little influence on children’s ability to resist advertising (Nairn & Fine, 2008; Rozendaal, Lapierre, et al., 2011). For example, a Dutch study of 296 children (eight to twelve years) reported that children’s familiarity with advertising and their understanding of advertising’s selling intent did not reduce their desire for the advertised product among younger children (Rozendaal et al., 2009). In this study, children completed an online survey about their advertising exposure, desire for advertised products and the extent to which their parents discussed advertising communications with them (Rozendaal et al., 2009). The same children then viewed 20-30 second advertisements or part of a television programme.

After viewing the advertisements, children were asked questions to measure their recognition of the advertisements, and their understanding of the selling and persuasive intent of the advertisements. Among children age ten to twelve years, knowledge of the persuasive intent of advertising did reduce the desire for the advertised product. However, the inverse was true for children in the eight to ten year-old category. Those eight to ten year-old children with a greater understanding of persuasive intent reported a greater desire for the advertised product than those with less persuasion knowledge (Rozendaal et al., 2009).

Similar findings were reported in a study of children’s advertising literacy and the effects of exposure to advertising within an advergame in the Netherlands. In this study, 105 children aged seven to twelve years twice played an advergame embedded with branding for Lays chips and Pepsi, playing for approximately three minutes in total (Van Reijmersdal et al., 2012). To gauge their understanding of the persuasive intent of the advergame, children were then asked who created the game and why they thought the game was available online. Of the children, only 40% understood that the game was created by Pepsi and Lays while 57% recognised the persuasive intent of the game. The findings of this study suggest that even among children that possess persuasive knowledge, they may have difficulty applying it to less familiar marketing techniques such as advergames (Van Reijmersdal et al., 2012). These findings are supported by Owen et al. (2013).
who reported that children's persuasive knowledge is context specific and therefore they may struggle to apply it to non-television advertising (Owen et al., 2013). Owen et al. (2013) reported that children had a clear understanding of television advertising's purpose but failed to evaluate non-traditional forms of advertising (including product placement, sponsorship, advergames) in the same way (Owen et al., 2013). This difference is likely because non-traditional forms of advertising are embedded within entertainment content and more difficult to recognise in comparison to television advertisements which are distinctly separated from programme content (Owen et al., 2013).

As discussed above, the recognition that a persuasive attempt is occurring is necessary for children to activate their cognitive defences to reduce the influence of advertising (Harris, Brownell, et al., 2009; Wright et al., 2005). Activating cognitive defences may be particularly difficult in the case of food marketing as children may struggle to resist an advertisement if it contains an appealing image of food (Harris, Brownell, et al., 2009). Harris, Brownell et al. 2009 argue that although the cognitive response and PKM approaches are useful psychological models to understand advertising influence, a separate model is required to understand the necessary conditions for children to defend against food marketing. They propose the use of the food marketing defence model, outlined in Figure 4.

As with the cognitive approach and the PKM, this model recognises that to defend against marketing, children must be consciously aware that a marketing exposure is occurring and actively recognise its persuasive intent (Harris, Brownell, et al., 2009). Further, they must understand the effects that result from the marketing exposure and how to successfully defend against them (Harris, Brownell, et al., 2009). This model also recognises that children must have the cognitive capacity and availability to apply their defences effectively. Importantly, the model also recognises that children must have the desire or motivation to resist food marketing. Harris, Brownell et al. (2009) argue that additional cognitive defences
are required to defend against food marketing to deter the desire for the highly appealing but unhealthy foods that are often depicted in food advertisements (Harris, Brownell, et al., 2009).

**Necessary conditions to effectively defend against unhealthy food marketing influence**

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<th>Motivation</th>
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<td>• Interest and desire to resist</td>
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**Figure 4 The food marketing defence model**

Many of these cognitive defence models require that children actively recognise and process advertising as they encounter it. However, evidence suggests that advertising is influential without active recognition and processing, particularly as children must consciously activate their cognitive defences, an automatic process
for adults (Chartrand, 2005; Dijksterhuis et al., 2005; McGuire, 1976; Nairn & Fine, 2008). The influential effect of advertising without the active recognition of the exposure is called the mere exposure effect. The mere exposure effect theorises that “mere repeated exposure of the individual to a stimulus is a sufficient condition for the enhancement of their attitude towards it. By mere exposure is meant a condition which just makes the given stimulus accessible to the individual’s perception (Zajonc, 1968, p.1).”

This theory is supported by a body of experimental research which reports that exposure to a brand or object enhances liking for the brand or object, without active recognition of the exposure (Bornstein, 1989; Hekkert et al., 2013; Olson & Thjømøe, 2003; Stafford & Grimes, 2012). For example, Stafford & Grimes (2012) investigated the influence of logo recognition on the mere exposure effect. Their study was conducted in the UK and involved 230 university students attending lectures for a 100 level psychology paper (Stafford & Grimes, 2012). The study had two phases. During the first exposure phase, students were exposed to ten unfamiliar brand logos over the course of their first three lectures for the paper. The logos were placed in the top right corner of the lecturer’s slides and were not discussed during the lecture. The students saw each logo nine times for an average total of 117 seconds each. The second phase involved testing the student’s preference for the brands they had been exposed to, their recognition of these brands, and how confident they were in their recognition. Student’s preferences for the brands they had seen during the exposure phase were tested by placing the brand logos they had seen alongside brand logos for an unfamiliar company or product that they had not seen during the exposure phase and selecting their preference (Stafford & Grimes, 2012). Students reported a preference for logos they had been exposed to, irrespective of whether they had reportedly recognised the logos during the test phase of the experiment (Stafford & Grimes, 2012).

The results of this study suggest that exposure to brand logos without recognition of the exposure positively affects preferences for that brand over alternatives
Further, this study reported that recognition of the brand enhanced the mere exposure effect (Stafford & Grimes, 2012).

The mere exposure effect may also influence preferences relating to purchasing behaviour. Shapiro et al. (1997) investigated the effects of incidental advertising exposure on the inclusion of the advertised products on purchasing lists in hypothetical buying situations. To investigate this, participants were asked to read an article on a computer screen that contained two embedded advertisements to the left of the screen, outside the main body of the article text. To ensure their focus remained on the article, participants were told that their memory and comprehension of the article would be tested. Further, the participants were also required to perform a cursor-moving task on the computer screen while reading the article (Shapiro et al., 1997). After reading the article, participants were exposed to hypothetical buying situations where they were asked to indicate products they would consider buying in those situations. Compared to the control group, who did not view the advertisements, participants who viewed the advertisements were more likely to report that they would consider buying the advertised products, even without recognising the advertisement (Shapiro et al., 1997).

Collectively, this research suggests that advertising’s influential effects may not depend on it being actively recognised or cognitively processed.

**Section summary**

Food marketing influences children through its effects as an agent of consumer socialisation. Children’s ability to resist marketing’s harmful effects depends on their stage of cognitive development, the extent of their defences and their ability to activate these defences at the time of exposure. However, the evidence suggests that knowledge of advertising’s persuasive intent does not adequately protect children from its influence. Further, children’s cognitive defences must be consciously activated and may be context specific. Therefore, these defences are likely better developed for television than for other types of marketing.
particularly those that are integrated into other media or the environment. In addition, marketing exposures may be influential without being actively recognised or processed. Finally, food marketing may be particularly difficult for children to resist as it is often presented in a very appealing manner.

**Chapter summary**

Childhood obesity is an important public health concern, internationally and in New Zealand, with significant health and economic implications. The environmental drivers of obesity are complex and include numerous influences on food choices and physical activity behaviours. Food marketing is a widely recognised environmental contributor to the development of childhood obesity owing to its influence on children’s preferences, consumption, purchasing behaviour and nutritional knowledge. The majority of foods marketed to children are high in fat, salt and sugar. Children are targeted by food marketers as they have spending capital, influence their parents’ spending, and have a lifetime as a consumer ahead of them. Children are also the population group most vulnerable to food marketing owing to their immature cognitive defences. However, the development of cognitive defences may not be adequate to protect them from the harmful influences of marketing. Food marketing is a particularly persuasive form of marketing. To effectively defend against its influence, children must actively recognise and understand the exposure and have ability and motivation to resist its influence. Food marketing is a pervasive presence in children’s environments and is marketed to them using a variety of different media.

The following chapter, Chapter Three, reviews the existing literature on the extent and nature of outdoor food advertising. Including the placement and clustering of outdoor advertising and differences in the extent and nature of outdoor advertising by neighbourhood demographic characteristics. Chapter Three also examines international examples of regulatory action to reduce and restrict food marketing to children, and reviews measures that have been introduced to restrict
outdoor advertising in major international cities. The regulation of outdoor advertising in New Zealand is also discussed. A discussion of the places in which children spend their time follows. In the final section of Chapter Three, I review existing methods of researching outdoor food advertising and explore alternative methods of assessing children’s outdoor advertising exposure.
Chapter Three: Outdoor Food Advertising

This chapter examines the available literature on outdoor food advertising, including its placement and nature, and socioeconomic differences in the presence and placement of this advertising. This chapter reports on worldwide actions to restrict food marketing to children and reviews measures that have been introduced to restrict outdoor advertising in major cities. This chapter then examines the existing regulations regarding outdoor advertising in New Zealand. A discussion of where children spend their time outside of the home and school environments follows. The final section reviews the existing methods of researching outdoor food advertising and explores possible methods of assessing children's exposure to this advertising.

Literature review search strategy

Six interconnected narrative reviews were conducted to canvas the literature on outdoor food advertising, its placement and regulation globally and in New Zealand, the importance of outdoor places for children, and existing methods of measuring outdoor food advertising.

Outdoor food advertising

The first of these was a review of the literature on outdoor food advertising which sought to investigate the use and effectiveness of outdoor advertising, identify the types of foods and drinks commonly advertised in the outdoor environment, and the location and placement of outdoor food advertisements. It also sought to determine if the placement or type (non-core or core) of outdoor food advertising was patterned by neighbourhood deprivation or ethnicity. To identify articles, major databases were searched using key words relating to outdoor food advertising, shop or store front advertising, neighbourhood deprivation and
ethnicity. I searched Scopus, Ovid Medline, Science direct, and Google Scholar, adapting the search strategy for use in each database. Searches were not limited by year of publication owing to the small body of existing literature on this topic.

The following is an example of the strategy used to search the Scopus database:

Search terms related to the use and effectiveness of outdoor advertising: “outdoor advertising” OR “out of home advertising” AND “effects”, “effectiveness”, “influence”, “purchase behaviour”.

Search terms related to outdoor food advertising: “outdoor food advertising”, OR “out of home food advertising” OR replace advertising with “marketing”, AND “shop front” OR store front.

Search terms related to outdoor food advertising patterned by neighbourhood deprivation: “outdoor food advertising”, AND “neighbourhood deprivation”, OR “neighbourhood income”, OR “deprivation”.

Search terms related to outdoor food advertising patterned by ethnicity: “outdoor food advertising”, AND “ethnicity”, OR “ethnic group”, OR “race” (to capture American articles).

Additional searches were run using the above search terms combined with “children”, “schools”, “convenience stores”, “supermarkets”, and “fast food” to capture articles that discuss the placement of outdoor advertising.

Searches conducted in Scopus, Ovid Medline and Science direct returned few results, not all of which were relevant. It is likely this was because the topic area spans multiple disciplines and the existing body of literature on outdoor food advertising is. In light of this, I conducted subsequent searches using Google Scholar to investigate other articles published by authors identified in the earlier searches. The University and ResearchGate profile pages of key authors in the areas were also searched. I also identified relevant articles in the references lists of the papers from the initial searches.
Regulation of food and beverage marketing to children and outdoor advertising restrictions

Subsequent reviews were conducted to identify international examples of restrictions on food and beverage marketing to children and examples of outdoor advertising restrictions. The examples of restrictions on food marketing to children were identified from the World Cancer Research Fund International NOURISHING Framework: Restrict food advertising and other forms of commercial promotion (World Cancer Research Fund International, 2017). Further information for each example was then sought by searching the relevant grey literature and legislation. Examples of outdoor advertising restrictions were initially identified by performing a Google search. Examples were included in the review if the piece of legislature that related to the restriction could be identified in the grey literature. Examples were excluded if the legislation could not be found or if the legislation was not in English and could not be readily and accurately translated using the translate feature in Google Chrome. Therefore, the examples of outdoor advertising restrictions included in this review do not constitute a complete list of all countries, states and territories that may have outdoor advertising restrictions.

Children’s places

In exploring children’s exposure to outdoor food advertising, I wanted to explore the literature on the places where children gather and spend time and whether the outdoor environment was viewed as an important place for children by children. Therefore, I conducted a brief review of the literature on children’s places and neighbourhoods. Initially, I used Scopus to identify articles relating to children’s neighbourhoods and places. However, as my search evolved, I used Google Scholar to further explore the other works of key authors in the field.

Regulation of outdoor and food advertising in New Zealand

To investigate the regulation of outdoor advertising and food advertising in New Zealand I initially conducted a review of the grey literature to identify central
government policies and legislation on the regulation of outdoor advertising and food advertising. I searched the websites of each of the four Wellington city councils to identify existing regulations and policies on outdoor advertising. I also searched the Advertising Standards Authority (ASA) website to identify existing codes that relate to advertising food to children in New Zealand.

**Measuring food marketing in the outdoor environment**

Methods of measuring outdoor food advertising were primarily identified in the primary research studies that were collected for the first section of the literature review. Information on other methods of participant observation was collected by searching the University of Otago Library catalogue to identify key authors and texts on this topic. Using the names of key authors identified from the Library search, a Google Scholar search was conducted to identify further relevant works from these authors. The literature on wearable cameras was obtained via a Google Scholar search as this literature is published in journals from a variety of disciplines ranging from computer science to public health.

**Outdoor food advertising**

Outdoor advertising is one of the many media channels contributing to the plethora of food and beverage advertising that children encounter daily. Non-broadcast media, including billboards, signage and posters are effective mediums through which food is marketed (Pasch & Poulos, 2013). Outdoor advertising, including billboards, posters, stickers, free-standing signs, banners, paintings on walls, and flags outside stores, has received less attention in the literature than other tradition media (Chacon et al., 2015; Taylor et al., 2006). For example, in their comprehensive reviews of food marketing to children, Cairns et al. (2009, 2013), and Hastings et al. (2006) do not specifically discuss food marketing in outdoor settings. However, outdoor advertising is an important marketing medium as it is embedded in the physical environment and children cannot avoid it in the same manner as advertisements on television or the internet can be
clicked away from (Lichtenthal et al., 2006; Wilson & Till, 2011). Outdoor advertising is used due to its high impact and reach, and the potential for repeated brand exposure and increased sales of the advertised product (Bhargava & Donthu, 1999; King & Tinkham, 1989; Kovačič, 2012). The available evidence suggests outdoor advertising is placed in close proximity to schools, early childhood education centres, main streets, public transport routes, convenience stores, fast food restaurants, shopping complexes, and sports and recreation venues (Adams et al., 2011; Gebauer & Laska, 2011; Isgor et al., 2016; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005; Powell et al., 2012; Settle et al., 2014). As these are places frequently visited by children, it is likely that children are frequently exposed to outdoor advertising in these settings, irrespective of whether they are the target audience. Research and international advertising expenditure data suggest that outdoor advertising disproportionately promotes unhealthy food and beverage products (Pasch & Poulos, 2013).

Although outdoor advertising represents a lesser share of advertising budgets than that spent on television or digital marketing, food and beverage industries spend millions of dollars per year on their outdoor advertising campaigns. For example, food and beverage (excluding fast food restaurants) industries in the US, spent an estimated $76.5 million on outdoor advertising in 2006 (Pasch & Poulos, 2013). Coca-Cola and Pepsi Co spent $30.5 million, while Cadbury Schweppes spent $6.8 million (Pasch & Poulos, 2013). Comparatively, in the same year, McDonald's spent $48.7 million on their outdoor advertising campaigns (Pasch & Poulos, 2013). New Zealand figures for food industry spending on outdoor advertising are not readily available. However, data on total outdoor advertising spend across all industries indicate that outdoor advertising is a growing market in New Zealand. In 2012, outdoor advertising accounted for $67 million or 3.1% of the total advertising industry revenue (Advertising Standards Authority, 2015). By 2016, outdoor advertising accounted for 118 million dollars or 4.6% of the annual advertising industry turnover (Advertising Standards Authority, 2017a).
Outdoor advertising is widely used as it is effective in generating recall of advertising messages, brand recognition and increased sales of the advertised product (Bhargava & Donthu, 1999; King & Tinkham, 1989). One study reported a sustained level of product awareness two months after the conclusion of a city-wide outdoor advertising campaign (King & Tinkham, 1989). Further, outdoor advertising at the point of sale serves as a powerful prompt to remind the consumer of the product at the time and place where purchase decisions occur (Isgor et al., 2016). Outdoor advertising remains a commonly used channel for food and beverage advertising and is expanding faster than most traditional marketing mediums (Taylor et al., 2006; Wilson & Till, 2011). Its appeal remains in its high reach, constant physical presence and potential for exposure to high volumes of people at relatively low cost, particularly when placed in highly visible locations, or in locations with potential for viewing by daily commuters (Taylor et al., 2006).

The effectiveness of outdoor advertising on brand awareness and product sales is positively related to exposure (Bhargava & Donthu, 1999). As such, the placement of advertising close to schools and other areas where children congregate is concerning as they may encounter this marketing daily (Chacon et al., 2015). Research on alcohol advertising suggests that exposure to advertising over time results in passive learning wherein associations form with the advertised product and individual values and goals, irrespective of the consumer’s attitudes or beliefs about the advertisement (Mazis, 1995). Mazis (1995) argues that the impact of this passive learning may be greater with non-traditional forms of marketing (such as sponsorship and outdoor advertising) than with television advertising, as the consumer may not interpret the message as advertising (Mazis, 1995).

Research has also found an association between outdoor advertising exposure and obesity risk (Lesser et al., 2013). This work, conducted in Los Angeles and Louisiana, reported a positive association between the number of outdoor advertisements for food and non-alcoholic beverages within a census tract and obesity among the resident population (Lesser et al., 2013). For every 10%
increase in the proportion of food and beverage advertisements within a census tract, there was a 5% increase in obesity risk among the residents, when controlling for age, ethnicity and education level (Lesser et al., 2013).

Outdoor advertising is a salient and effective medium of advertising food and beverage products. Further, the available evidence suggests that it is an important marketing medium that may contribute significantly to children’s exposure to unhealthy food and beverage marketing (Chacon et al., 2015; Kelly, Cretikos, et al., 2008).

**Placement of outdoor advertising**

Outdoor food advertising is strategically placed to maximise visibility and facilitate repeated exposures in public places (Bhargava & Donthu, 1999; Lichtenthal et al., 2006). As discussed above, the existing literature suggests that outdoor advertising clusters around schools and other child-serving institutions, shopping areas, public transport facilities and main streets.

**Schools**

Outdoor food and drink advertisements are common in the immediate geographical area around schools and largely promote non-core food products, that is, those that are high in fat, salt and or sugar (Chacon et al., 2015; Gebauer & Laska, 2011; Hillier et al., 2009; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005; Walton et al., 2009).

**Nature of outdoor food advertising around schools**

New Zealand research reports that 61 to 70% of outdoor food advertisements in the areas immediately around primary and secondary schools are for HFSS products (Maher et al., 2005; Walton et al., 2009). Similarly, around Australian primary schools, 80% of outdoor advertisements were for non-core foods (Kelly, Cretikos, et al., 2008). Comparable research conducted in Ulaanbaatar (Mongolia) and Manilla (Philippines) reported that between 85 and 92% of food
advertisements around schools were for non-core foods (Kelly, King, et al., 2015). Further, a US study of storefront food advertising on convenience stores within 800m of schools reported that 94% of all food advertisements on storefronts were for non-core foods (Gebauer & Laska, 2011).

In the areas around schools, there are reportedly few outdoor advertisements for core foods. New Zealand research reported an average of only 2.8 healthy (core), compared with an average of 12.5 unhealthy (non-core) outdoor food advertisements within a 2km radial buffer of four Wellington primary schools (Walton et al., 2009).

Similarly, in their study of outdoor advertising around 40 Australian primary schools, Kelly et al. (2008) calculated the rate of outdoor food advertising per square km, by distance from the primary schools. Within 500m of each of the primary schools, there was an average density of 3.7 core outdoor food advertisements per square km. Comparatively, within the same distance from primary schools, there was an average density of 70.5 non-core food advertisements per square km.

Research conducted around 60 schools in Mongolia and the Philippines also reported a disproportionately high percentage of non-core versus core food advertisements. Within a 500m radius of each school, an average only 6% of the outdoor food advertisements were for core foods and drinks. Comparatively, 88.5% of food advertisements were for non-core foods, and 5.5% were for miscellaneous food products (e.g. tea and coffee) (Kelly, King, et al., 2015). Interestingly, a small scale New Zealand study reported that 29.8% of the outdoor food advertisements within a 1km radius of 10 secondary schools were for core food products (Maher et al., 2005). However, it is likely that this figure is an overestimate as the core category in this study included fruit juices and sports drinks which are classified as non-core in all other literature presented in this chapter. Despite this, 70.2% of the food advertisements identified by Maher et al. (2005) were for non-core food products.
Of the non-core foods advertised around schools, advertisements for sugar-sweetened beverages (SSBs) (including soda, fruit juice/drinks, energy drinks), sweet and savoury snacks, fast food and frozen confectionery (e.g. ice cream) were the most numerous (Chacon et al., 2015; Gebauer & Laska, 2011; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005). Around New Zealand and Australian schools, advertisements for sugar-sweetened beverages (SSBs) accounted for 23% and 24% of all non-core outdoor food advertisements, respectively (Kelly, Cretikos, et al., 2008; Maher et al., 2005). Comparatively, outdoor advertisements for SSBs accounted for 62% of non-core outdoor advertisements around schools in Ulaanbaatar and Manilla, and 67% of outdoor advertising around schools in Guatemala (Chacon et al., 2015; Kelly, King, et al., 2015). However, around New Zealand schools, outdoor advertisements for frozen confectionery (16.2%), takeaways and fast food (13.3%) and savoury snacks (11.4%), and dairy products (7%) also featured prominently (Maher et al., 2005).

The nature of the foods promoted by outdoor advertisements is consistent with those reported across all marketing mediums. As discussed in Chapter Two, marketing for soft drinks, fast food, high sugar breakfast cereals, confectionery, and savoury snacks are among the most commonly promoted food products across all marketing mediums (Cairns et al., 2013).

**Clustering of outdoor food advertising around schools**

International research consistently reports the clustering of outdoor food advertisements within a 2km radius of primary and secondary schools (Chacon et al., 2015; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005; Walton et al., 2009). Although studies of outdoor food advertising around schools have used different radial buffer sizes, the findings are largely consistent. For example, in a study of outdoor advertising within a 500m radius of 40 primary schools across Sydney and Wollongong, Kelly et al. (2008) identified 9151 advertisements, 2286 (approximately 25%) of which were for food products. Of these advertisements, 1834 (approximately 80%) were for non-core foods, that is, those inconsistent with government healthy eating guidelines (Kelly, Cretikos, et
Similarly, research conducted in Wellington (New Zealand) surveyed all food and non-food advertisements within a 1km radius of 10 secondary schools (Maher et al., 2005). Of the 1408 advertisements surrounding the ten schools, 866 (61.5%) were for food products, with an average of 87 outdoor food advertisements within a 1km radius surrounding schools (Maher et al., 2005).

Further, a recent study conducted in two cities, Ulaanbaatar and Manila, investigated the density of outdoor food and beverage marketing within a 500m radius of 30 schools in each city (Kelly, King, et al., 2015). In Ulaanbaatar, there was an average of 18 food advertisements within a 250m radius of schools and an average of 31 advertisements further from the schools (≥250m and ≤500m) (Kelly, King, et al., 2015). Similarly, in Manilla, there were fewer advertisements within the 250m radius, 128 compared to 195 between 250 and 500m from the schools (Kelly, King, et al., 2015). In Ulaanbaatar, an average of 66 non-core products were advertised within the area surrounding each school (Kelly, King, et al., 2015). In contrast, there was an average of 282 non-core advertisements in the area around the 30 schools in Manila (Kelly, King, et al., 2015).

**Density of outdoor food advertising around schools**

The density of outdoor food advertisements also reportedly increases with increasing proximity to schools (within 250m) (Chacon et al., 2015; Kelly, King, et al., 2015). An observational study conducted in Guatemala sought to document the types of snack foods advertised within a 200m radius around two preschools and two primary schools and to assess child-oriented snack food advertising at 55 stores in these locations (Chacon et al., 2015). All stores had a median of one child-oriented snack food advertisement on the store exterior (Chacon et al., 2015). This number increased to two with increasing proximity (<170m) to the school gate. Almost half (49.1%) of all stores had interior advertisements that could be seen from the street (Chacon et al., 2015). The percentage of stores with visible interior advertisements was higher within 170m (59.3% versus 40.7%) from the school gate (Chacon et al., 2015).
Similar findings were reported by Kelly et al. (2015) in their study of outdoor advertising around schools in Ulaanbaatar and Manilla. The authors found a higher density of food advertisements within a 250m radius versus a 500m radius from each school (Kelly, King, et al., 2015). These findings are consistent with those reported in a comparable Australian study (Kelly, Cretikos, et al., 2008). The density of both core food advertisements and non-core food advertisements was almost twice as high within the 250m radius than the 500m radius from schools in Sydney and Wollongong (Kelly, Cretikos, et al., 2008). The average density of food advertisements within a 250m radius of schools was 115 per km² compared to 59 per km² in the area further from schools (Kelly, Cretikos, et al., 2008).

Although the above studies have documented and described the outdoor food advertising around primary and secondary schools, they have not attempted to quantify children’s exposure to the advertising. Only one of the studies reviewed here has attempted to determine children’s exposure to outdoor advertising. Using a novel approach, Walton et al. (2009) mapped the number of food outlets and outdoor food advertisements within a 2km buffer of four Wellington schools using geographic information systems (GIS). Residential addresses of each participant were used to calculate the number of outlets and outdoor food advertisements each of the participant’s passed on their journey to school (Walton et al., 2009). However, the route used to calculate the number of exposures encountered on the journey to and from school was the shortest distance, through the road network, from the participant’s house to their school. As such, the route used in this study may not have been the actual route the participants took to school. Using the assumed route, an average of 66% of students from all schools passed at least one advert or food outlet on their journey to and from school (Walton et al., 2009). These students passed an average of 9.3 advertisements or food outlets on the journey to and from school (Walton et al., 2009). In this study, food outlets and food adverts were reportedly identified on the majority of streets near all schools (Walton et al., 2009).
Overall, previous research indicates that outdoor food advertising clusters around schools, with the highest density of food advertising found within a 250m radius of the schools. Further, the outdoor food advertising surrounding schools is largely for non-core foods with advertisements for SSBs, fast food, ice cream, frozen confectionery, and snack foods being the most common.

**Shopping areas**

The available evidence suggests that outdoor food advertising is common on the exterior of convenience stores, supermarkets, and in other shopping areas, and clusters around major roads and fast food outlets (Gebauer & Laska, 2011; Isgor et al., 2016; Powell et al., 2012). In an assessment of the exterior advertising associated with 2442 fast food outlets across the United States (Powell et al., 2012), approximately 80% of all fast food restaurants had some form of outdoor advertising on the exterior of the building. External advertising was almost universal for chain fast food stores, with 91% of stores displaying advertising on the exterior of the premises (Powell et al., 2012).

These findings are supported by a nationwide survey conducted in the US that investigated the nature and extent of advertising on the exterior of 8959 randomly-selected supermarkets or convenience stores (Isgor et al., 2016). Food and beverage advertisements were present on the exterior of 73.0% of convenience stores and 58.6% supermarket/grocery stores (Isgor et al., 2016). Advertisements for fruit and vegetables were more common at supermarkets (26.3%) than convenience stores (2.7%) (Isgor et al., 2016). Advertisements containing price promotions were more common at convenience stores (54.3%) than supermarkets (39.9%), as were advertisements for sugar-sweetened soda which were present on 41.3% of convenience stores and 15.8% of supermarkets (Isgor et al., 2016). Further research from Minnesota supports these findings. Of the 63 convenience stores found within 800m of 26 Minnesota secondary schools, 52 (83%) stores had exterior food and beverage advertising that was visible from the street (Gebauer & Laska, 2011).
Several studies have reported that the outdoor food advertising around schools is primarily associated with shopping areas and food outlets (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005). New Zealand research reported that almost all (96.5%) outdoor food advertisements around schools were associated with retail outlets, the remaining advertisements were either on billboards or bus shelters (Maher et al., 2005). Similarly, in two cities in the Asia-Pacific region, the majority of outdoor food advertisements around schools were found in shopping areas (59% for Ulaanbaatar and 86% in Manila) (Kelly, King, et al., 2015).

Outdoor food advertising is a common feature on the exterior of food retail outlets and may contribute significantly to the amount of outdoor advertising found in neighbourhoods.

**Main streets and transit stops**

Outdoor food advertising is commonly seen at public transportation stops and stations and is widely visible on the main streets of most cities worldwide (Adams et al., 2011; Kelly, King, et al., 2015; Settle et al., 2014). Outdoor advertising is placed in highly visible locations such as these to facilitate viewing by a large number of people who may pass these features multiple times per day during their commute to school or the workplace (Bhargava & Donthu, 1999; Lichtenthal et al., 2006; Taylor et al., 2006).

There is a growing body of evidence about the extent of food advertising at public transportation stops. Research conducted in Melbourne assessed all train stations, and bus and tram stops with an associated shelter using a purpose-developed observational audit tool (Settle et al., 2014). A total of 233 food advertisements were identified at 558 public transportation stops (Settle et al., 2014). Socioeconomic differences in advertising were evident, with a mean of 13.6 advertisements identified in the least deprived suburbs compared with a mean of 9.7 advertisements in the most deprived suburbs (Settle et al., 2014). Transit stops in areas of both high and low deprivation had advertisements for cold
beverages, hot beverages, and snack food, fast food, and dairy products (Settle et al., 2014). Diet drinks were advertised more frequently in the least deprived than the most deprived areas (57% versus 25%) (Settle et al., 2014). Advertisements for fruit juice and flavoured milk were also more common in areas of low deprivation than high deprivation (Settle et al., 2014). Interestingly, no advertisements for cereals, fruits, vegetables, or sugar-sweetened soft drinks were identified during the study period (Settle et al., 2014).

Using similar methods, researchers systematically assessed all print advertisements within 68 subway stations in the Bronx, New York City (Lucan et al., 2017). Of the 68 stations surveyed, 37 contained print advertising. Of which, 27 (73%) had food advertisements (Lucan et al., 2017). A total of 163 food or beverage advertisements were recorded at subway stations, representing advertisements for 43 distinct products (Lucan et al., 2017). Overall, two-thirds (67.4%) of food advertisements were for “less healthful” products as consistent with the Dietary Guidelines for Americans including confectionery, snack foods, high sugar cereals and frozen pizzas (Lucan et al., 2017). However, in this study, beverage advertisements (58.6%) outnumbered those for food (41.4%) (Lucan et al., 2017). Among the most common were advertisements for energy drinks and other caffeinated beverages and alcohol (beer and spirits) (Lucan et al., 2017). Interestingly, 31 of the surveyed stations did not have any visible advertising. In place of advertising these stations had artworks or mosaic tiling (Lucan et al., 2017).

Research conducted in Accra, Ghana, also reported that outdoor advertisements for beverages were a common feature on city streets. This recently published study examined the nature of outdoor non-alcoholic beverage advertisements on city streets in Ghana (Bragg et al., 2017). Of the 77 outdoor beverage advertisements identified within a 4.7 km² area of Accra, Ghana, 73% were for sugar-sweetened beverages (Bragg et al., 2017).
In Australia, Kelly et al. (2008) also reported a large amount of advertising for food products on main streets and at public transport stops. On main streets, 68% of food advertising was for non-core foods (Kelly, Cretikos, et al., 2008). This figure was similar at bus shelters (70%), while 90% of food advertisements at train stations were for non-core foods (Kelly, Cretikos, et al., 2008). In Newcastle (UK), food advertisements were also found primarily in the areas around shops and along bus routes (Adams et al., 2011). A total of 15% of all outdoor advertisements were for food. However, food advertisements accounted for 20% of total advertising space (Adams et al., 2011). Within the Newcastle city limits, researchers recorded 211 food advertisements (Adams et al., 2011). Almost half of food advertising space was devoted to foods and drinks high in fat, salt or sugar (this excluded fast food which was included in a ‘mixed’ food category) (Adams et al., 2011). Food advertisements were most common in areas of high socioeconomic deprivation (Adams et al., 2011).

Food advertising along major roadways and transit stops is a common feature in many cities. The evidence suggests that this advertising is often for high fat, salt and sugar foods that are low in beneficial nutrients and also suggests that advertising for less nutritious foods may be more common in areas of greater socioeconomic deprivation.

**Socioeconomic and ethnic differences in the extent and nature of outdoor food advertising**

Studies conducted in the US and the UK report distinct socioeconomic differences in the presence and types of outdoor food advertising (Adams et al., 2011; Isgor et al., 2016; Powell et al., 2012; Yancey et al., 2009). In the US, supermarkets in low-income areas were 1.7 times (p<0.05) as likely to display external food and beverage advertisements as those in high-income areas (Isgor et al., 2016). Supermarkets in low-income areas were also more likely to display external advertisements containing price promotions for food and drink and were more likely to display advertisements for sugar-sweetened soda than supermarkets in
high-income areas (Isgor et al., 2016). Each of these findings was statistically significant. Similarly, convenience stores in low-income areas were 35% more likely to display advertisements for sugar-sweetened sodas and were 47% less likely to display advertisements for fruits and vegetables than similar stores in high-income areas (Isgor et al., 2016). Again, these findings were statistically significant.

Further, research conducted in the US reported a greater number of outdoor advertisements for EDNP products (including fast food and sugary beverages) in low-income zip codes, irrespective of the majority ethnic group (Yancy et al., 2009). In low-income areas, there was an average of 325 advertisements for EDNP products whereas in high-income zip codes there were 154 such advertisements (Yancy et al., 2009). Advertising space dedicated to food advertising was also approximately 4.5 times greater in low versus high-income areas (Yancy et al. 2009). A study of outdoor advertising conducted in Los Angeles and Louisiana reported that low-income areas had greater odds of having any outdoor food advertisements than wealthier areas (Lesser et al., 2013). Similarly, the proportion of advertisements for food was significantly higher in the least affluent areas of Newcastle compared with wealthier areas (Adams et al., 2011). Further, advertising space dedicated to food products was highest in the least affluent areas (Adams et al., 2011).

In their survey of exterior advertising on fast food restaurants across the US, Powell et al. (2012) reported that a greater proportion of restaurants had external food advertising in low income (86%) versus high income (76%) neighbourhoods (Powell et al., 2012). This difference was statistically significant. External food advertising was also more common on restaurants in majority African American (88%) and Hispanic (87%) neighbourhoods than majority European (79%) neighbourhoods (p<0.05) (Powell et al., 2012). Price promotions were present on 75% of exterior adverts at chain fast food restaurants (Powell et al., 2012). Such promotions were also significantly (p<0.05) more common in low income (89%)
than high income (69%) areas, and in majority Hispanic neighbourhoods (88%) compared with majority European neighbourhoods (72%) (Powell et al., 2012).

Internationally, there are pronounced socioeconomic differences in outdoor advertising, with considerably greater outdoor food and beverage advertising observed in the areas of highest deprivation. In New Zealand, the density of food retail outlets and their proximity to schools is patterned by area-level socioeconomic deprivation (Sushil et al., 2017; Vandevijvere et al., 2016). Results of a recent (2015) New Zealand survey of food retail outlets reported a higher density of outlets in areas of high socioeconomic deprivation (Sushil et al., 2017). This study conducted a national spatial analysis of the location of 4087 convenience stores, 4316 fast food/takeaway outlets, and 1271 supermarket and fruit and vegetable stores, and calculated the density of the outlet types for census area units across the country (Sushil et al., 2017).

Associations between area-level socioeconomic deprivation and outlet density were calculated. Deprivation was assessed using the New Zealand Deprivation Index 2013 (NZDep2013).¹ Reportedly, the availability of all stores was significantly higher in the most deprived areas (NZDep2013 deciles 9 and 10) than in the least deprived areas (NZDep2013 deciles 1 and 2) (Sushil et al., 2017). The results indicated that the density of food retail outlets increased with increasing area-level deprivation (Sushil et al., 2017).

Using data from the same national survey, another study investigated the food retail environment surrounding New Zealand schools (Vandevijvere et al., 2016). This study assessed the proximity of primary and secondary schools to food retail outlets as well as the density of food outlets within an 800m radius of each school

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¹ The New Zealand Deprivation Index (NZDep) is a non-occupational, area-based measure of relative socioeconomic deprivation (Salmond & Crampton, 2012a). NZDep2013 was developed using the results of nine questions relating to the following eight dimensions of socioeconomic deprivation collected during the New Zealand census: communication (internet access at home), income, employment status, qualifications, home ownership, social support, household crowding, and car access (Atkinson et al., 2014). The index was designed to provide information on the relative deprivation of those living in area mesh blocks of approximately 100 people (Atkinson et al., 2014). Areas are assigned a decile rating from 1 (least deprived) to 10 (most deprived).
(Vandevijvere et al., 2016). The authors reported significant socioeconomic differences. The road distances to convenience stores were closer to schools in the most deprived areas (median road distance 521m) than those in the least deprived areas (617m) (Vandevijvere et al., 2016). Further, a national study of the accessibility of fast food outlets across New Zealand revealed that those living in areas of high deprivation had the greatest access to fast food outlets and that fast food outlets were more accessible to schools in high deprivation areas (Pearce et al., 2007).

However, small-scale New Zealand research has reported the inverse situation, wherein outdoor food advertising is more prevalent in the least deprived areas (Maher et al., 2005). Among schools in the Wellington region, food advertisements for takeaway outlets and fast food franchises appeared more frequently in areas of low socioeconomic deprivation (Maher et al., 2005). Although there has been no large-scale research on outdoor food advertising in New Zealand, local research suggests that outdoor advertising around schools is usually associated with food retail outlets (Walton et al., 2009). However, the research by Maher et al. (2005) assessed the area within a 1 km radius of 10 schools in the Wellington region, five of which were in rural areas. Therefore, the findings may not be representative of the neighbourhood prevalence of outdoor food advertising nationally. The study also focussed on a small geographical area surrounding secondary schools and did not include the wider neighbourhood.

Collectively, the available research suggests that outdoor food advertising in New Zealand may be more prevalent in the most deprived areas as it is primarily associated with food retail outlets. However, large-scale research is needed to assess socioeconomic differences in the extent and nature of outdoor food advertising in New Zealand.

**Ethnic differences**

Evidence from the US indicates that outdoor advertising clusters in neighbourhoods with a high proportion of residents from minority ethnic groups
(Cassady et al., 2015; Hillier et al., 2009; Yancey et al., 2009). For example, in a study of outdoor obesity-related advertising (including advertisements for non-core foods, and sedentary entertainment and transport) in Los Angeles, Austin, New York City and Philadelphia, the density and type of advertising in each zip code were patterned by ethnicity (Yancey et al., 2009). The density of obesity-related advertising was considerably greater in majority Hispanic (123.54 advertisements/square mile) and African American (84.12 advertisements/square mile) zip-codes compared with European zip-codes (12.60 advertisements/square mile). Although the advertising density was highest among low-income African American and low-income Hispanic zip-codes, the density of obesity-related advertising was higher among high-income African American and Hispanic zip-codes than high-income European zip-codes (Yancey et al., 2009). These findings suggest that this effect may be independent of median zip-code income. In a separate study conducted in three US cities, authors reported that the clustering of advertisements around child-serving institutions was inversely related to the proportion of Europeans in the area, and positively associated with the proportion of African-American and Hispanic groups (Hillier et al., 2009). This effect was independent of median neighbourhood income (Hillier et al., 2009).

The presence of food and beverage advertisements in supermarkets and convenience stores also reportedly differs according to the majority ethnic group within the community (Isgor et al., 2016). Food advertisements on supermarket exteriors were significantly (p<0.01) more common in majority African American (75.9%) and Hispanic (69.3%) communities than in European (57.1%) communities (Isgor et al., 2016). Advertisements for sugar-sweetened soda were significantly (p<0.01) more common in majority African American (30.5%) and Hispanic (24.4%) neighbourhoods than majority European neighbourhoods (14.3%) (Isgor et al., 2016). Further, the proportion of convenience stores with soda advertisements was significantly (p<0.05) higher in African American
(48.1%) communities than stores in European communities (42.2%) (Isgor et al., 2016).

Similar to the US, New Zealand neighbourhoods are patterned by socioeconomic deprivation and ethnicity. Māori are overrepresented in the areas of greatest socioeconomic deprivation (Ministry of Health, 2015). In 2013, 40.9% of Māori lived in the most deprived neighbourhoods (NZDep2013 deciles 9 and 10) compared with 15.3% of non-Māori. Māori are also underrepresented in the least deprived neighbourhoods (NZDep2013 decile 1 and 2) making up just 8.6% of the resident population compared with 23.3% of non-Māori (Ministry of Health, 2015). Pacific groups are also overrepresented in the areas of greatest socioeconomic deprivation. In 2006, 56.5% of Pacific people lived in NZDep2006 deciles 9 and 10 (White et al., 2008).

**Summary**

Outdoor advertising is a significant contributor to children’s overall exposure to food marketing, and the evidence suggests that it is a powerful and effective medium for building brand awareness and recognition (Bhargava & Donthu, 1999; Lichtenthal et al., 2006; Taylor et al., 2006). However, much of the available information on the extent and nature of outdoor food and beverage advertising, reviewed in this section, comes from small-scale cross-sectional studies (Adams et al., 2011; Bragg et al., 2017; Lucan et al., 2017; Maher et al., 2005; Settle et al., 2014; Walton et al., 2009). Some of the more robust evidence presented in this section comes from nationwide surveys (Isgor et al., 2016; Powell et al., 2012) and larger studies of the extent and nature of outdoor advertising in multiple cities (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015).

The literature presented in this section suggests that the majority of outdoor food advertisements are for foods or beverages that are high energy, fat, salt and sugar. Although there was variation across studies reviewed in this section, 61% to 94% of outdoor food advertisements were for unhealthy food products (Gebauer & Laska, 2011; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al.,
There were also similarities in the most commonly advertised food groups across all of the studies. Soft drinks, ice cream and iced confectionary, sweet and savoury snacks, and fast food were the most commonly advertised food products in these studies (Chacon et al., 2015; Gebauer & Laska, 2011; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005). The literature reviewed in this section also suggests that outdoor food advertisements cluster around schools, with a greater number of advertisements found nearer to schools, particularly schools in low socioeconomic areas (Chacon et al., 2015; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015).

Previous research also suggests that the amount of unhealthy outdoor food advertising is higher in low socioeconomic areas and areas with greater proportions of minority ethnic groups (Adams et al., 2011; Isgor et al., 2016; Powell et al., 2012; Yancey et al., 2009). Although there appears to be strong evidence of this in the US, the evidence for socioeconomic or ethnic trends appears to be less definitive from current New Zealand evidence. Recent evidence suggests that in New Zealand there is a higher density of food retail outlets in the most deprived areas and food retail outlets are also closer to schools in the most deprived areas (Sushil et al., 2017; Vandevijvere et al., 2016). However, earlier research reported that outdoor food advertising was more prevalent in the least deprived areas (Maher et al., 2005). On balance, the greater presence of food retail stores in the most deprived areas likely indicates that outdoor food advertising may be more prevalent in the most deprived areas of New Zealand.

To date, the literature in this area has focused on quantifying the nature and extent of outdoor food advertising in and around schools, at retail outlets, at transit stops and, to a lesser extent in main streets. The focus on neatly geographically defined features of the environment provides some insight into children's exposure to outdoor advertising. However, gaps in the literature remain as the extent of children’s exposure to outdoor food marketing in transitory spaces, outside of the home, school and retail environments appears to be largely unexplored. Further, much of the research presented has focused on documenting
the presence of food marketing in the outdoor environment and has made little attempt to estimate children’s exposure to this marketing. Quantifying children’s exposure to outdoor food advertising is necessary to identify key sources of children’s exposure to this advertising, and to inform the development of interventions to reduce children’s exposure to outdoor food advertising. The following section reviews worldwide action on the restriction of food marketing to children and examines those actions specifically related to outdoor food advertising.

**Worldwide action on the restriction of food and non-alcoholic beverage marketing to children**

In spite of repeated calls for member states to take action to protect children from food and beverage marketing, to date, no member state has implemented comprehensive and mandatory legislative restrictions on the marketing of food and non-alcoholic beverages to children (Kraak et al., 2016). A survey of policy actions to regulate food marketing in 59 countries revealed that only 22 countries had policies on food marketing to children ranging from government approved self-regulation, government encouraging voluntary self-regulation, to statutory regulations (Hawkes & Lobstein, 2011). The types of self-regulation include: independent self-regulatory organisations set up to monitor food advertising (such as the Office of Communications, Ofcom, in the UK), advertising associations, and food industry groups set up to develop or contribute to advertising codes on food marketing to children (Hawkes & Lobstein, 2011). However, these self-regulatory codes often fail to outline specific restrictions on the scheduling of advertising, and media and techniques used. They also fail to provide specific nutrient criteria for the advertised food products (Hawkes & Lobstein, 2011). Instead, the codes typically consist of general principles suggesting that food advertising be distinguishable from programming content and should not be misleading or deceptive. Further, these codes suggest that advertising should not
promote excess consumption or undermine the role of parents or guardians in the promotion of a healthy diet (Hawkes & Lobstein, 2011).

Self-regulation remains a favoured policy approach by many governments including Australia, the US, Canada and Germany. In these countries, governments have endorsed a self-regulatory approach without approving or endorsing a specific code or set of guidelines (Hawkes & Lobstein, 2011). In contrast, government approved self-regulatory measures are in place in numerous countries including Denmark, France, Belgium, Spain and Norway. In these countries, policies on the marketing of food to children have been developed by government in cooperation with the food industry, or at the request of the government, and are regulated by industry (Hawkes & Lobstein, 2011). However, these measures have been ineffective in substantially reducing the extent of children’s exposure to food and non-alcoholic beverage marketing (Kraak et al., 2016). As such, statutory regulations have become increasingly common and have been introduced in a number of countries including, the United Kingdom, Ireland, South Korea, Brazil and Chile (Hawkes & Lobstein, 2011; World Cancer Research Fund International, 2017).

**United Kingdom**

In 2007, the UK banned the advertisement and placement of HFSS during, before, and after television and radio programmes intended for children under 16 years (Ofcom, 2010). Ofcom, the independent regulatory body for all broadcast communication services in the UK, enforces the ban on HFSS advertising which was fully implemented by the end of 2008 (Ofcom, 2010). A nutrient profiling model (NPM) is used to determine the eligibility for food products to be advertised. This NPM was developed by the UK Food Standards Agency (UKFSA NPM) with input from the UK Scientific Advisory Committee on Nutrition, independent nutritionists, dietitians, and industry and consumer representatives (Rayner et al., 2009). This NPM was developed specifically to restrict food
marketing to children and takes into account the balance of positive and negative nutrients within a food product. The model produces a final score for each food product, which consequently determines if it can be advertised to children. The score is negatively influenced by the energy, saturated fat, sugar, and sodium content per 100g of the product, while the protein, fibre, fruit, vegetable and nut content positively modify the score. Details of the scoring criteria are available elsewhere (Rayner et al., 2009).

**Ireland**

In Ireland, the promotion of HFSS foods (as determined by the UKFSA NPM) through advertising, sponsorship, and product placement is prohibited during all television shows, and radio broadcasts where greater than 50% of the audience is under 18 years of age (Broadcasting Authority of Ireland). These restrictions came into effect in September 2013. In addition to these restrictions, there is a general limit on the number of advertised HFSS foods during all viewing hours; this is limited to 25% of sold advertising time (Broadcasting Authority of Ireland, 2013).

**Norway**

In Norway, restrictions on advertising to children (<18 years) are not limited to food and beverages. Under the Norwegian Broadcasting Act No. 127 1992, advertisements for consumer products cannot be broadcast during children’s television, radio, or Teletext programming and cannot target children (Norwegian Ministry of Culture, 2005). Further, advertisements must not exceed 15% of the total daily broadcasting time (Norwegian Ministry of Culture, 2005). However, these restrictions only apply to broadcast media. In 2013, the Norwegian government and the food industry agreed on a voluntary initiative to further restrict food marketing to children (<13 years) via a broader range of media (World Cancer Research Fund International, 2017). The Norwegian Ministry of Health also developed an agreement with the beverage industry to restrict soft
drink advertising to children less than 12 years old (World Cancer Research Fund International, 2017). These restrictions only apply to television and cinema mediums and only when greater than 50% of the audience is children. However, the restrictions also apply to internet advertising (World Cancer Research Fund International, 2017).

South Korea

In 2008, the South Korean government introduced the Special Act on the Safety Management of Children's Dietary Life (Special Act) (Ministry of Food and Drug Safety, 2008). Under this act, restrictions on the advertisement of EDNP foods to children aged 4-18 years were introduced on January 1, 2010 (Ministry of Food and Drug Safety, 2008). The Act prohibits the advertisement of EDNP foods before, during and after children’s television programmes between 5pm and 7pm and during children’s programmes irrespective of viewing time (Kim et al., 2013). EDNP foods were defined using the nutritional standards developed by the Korean Food and Drug Administration (Kim et al., 2013). Under the Special Act, the Korean government also introduced “green food zones” to prevent the sale of fast food and sugar-sweetened beverages within 200m of certain schools (Ministry of Food and Drug Safety, 2008). Food and beverage advertising is also prohibited within the green food zones (World Health Organization, 2012c).

Australia

In 2009, the Australian Association of National Advertisers developed the Food and Beverages Advertising and Marketing Communications Code (Australian Association of National Advertisers, 2011). However, compliance with the code is voluntary, and is self-regulated by the advertising industry (Australian Association of National Advertisers, 2011). The code was introduced to “ensure that advertisers and marketers develop and maintain a high sense of social
responsibility in advertising and marketing food and beverage products in Australia” (Australian Association of National Advertisers, 2011. p.1).

**Chile**

In 2012, the Law of Nutritional Composition of Food and Advertising (Law 20,606) was approved by the Chilean government. This law was designed to restrict the marketing of high calorie and HFSS foods to children under the age of 14 (Ministry of Health Chile, 2012 ). The law comprehensively prevents the marketing of food via all promotional channels, including television and websites with a child audience of more than 20%, as well as radio, and magazines (Ministry of Health Chile, 2012 ). The law is also broader than in most countries, banning the advertisement or promotion of foods in pre, primary and secondary schools (Ministry of Health Chile, 2012 ). The law also prohibits the use of certain promotional techniques with specific appeal to children including collectable toys, gifts, contests, games and other promotional appeals designed to catch children’s attention (Ministry of Health Chile, 2012 ).

Like Chile, other countries have begun to widen the scope of their advertising restrictions to reduce children’s exposure to marketing across different mediums.

**Brazil**

In 2014, Brazil introduced the CONANDA Resolution (No. 163 3/03/14) to establish criteria to restrict advertising targeted to children (<11 years) and adolescents (aged 12 to 18 years) through all marketing communications (National Council for the Rights of Children and Adolescents, 2014). The National Council introduced the resolution for the Rights of Children and Adolescents, coordinated by the Federal government. Under Article One of this resolution, marketing communications are defined broadly to include:

Any commercial communications activity, including advertising for the promotion of products, services, brands and companies regardless of the media or medium used. Marketing
communication covers, among other tools, television, print, commercials, radio advertisements, Internet banners and websites, packaging, promotions, merchandising, the point of sale promotions as well as promotional material at concerts or public performances (National Council for the Rights of Children and Adolescents, 2014. p. 1).

The resolution also restricts the marketing techniques used to target promotions to children. Namely:

Advertisements showing children using or consuming a product, audio of children speaking or singing, children friendly language and typography, the use of colours to target children, cartoons or animation, dolls or puppets. The resolution also restricts the use of celebrities or people that appeal to children, the use of collectable gifts or prizes and competitions or games that appeal to children to promote products (National Council for the Rights of Children and Adolescents, 2014. p. 1-2).

These restrictions are among the most comprehensive in the world. They apply to advertising and marketing communications in all places including public spaces, websites, television at all times and cover all mediums and media, irrespective of whether the product or service is intended for a child, adolescent or adult audience (National Council for the Rights of Children and Adolescents, 2014). The resolution also explicitly prohibits any form of marketing in daycare, and early childhood education facilitates. These restrictions are enforced under the Consumer Defence Code (Law 8078/1990) and the Child and Adolescent Statute (Law 8069/1990) (World Cancer Research Fund International, 2017). However, in practice, these restrictions have been difficult to enforce (World Cancer Research Fund International, 2017).

**Peru**

In Peru, The Law on the Promotion of Healthy Eating for Children and Adolescents (Ley de Promoción de la Alimentación Saludable para Ninos, Ninas y Adolescentes) was voted in on May 17th, 2013 by the Peruvian Congress to reduce childhood overweight and reduce the incidence of obesity-related NCDs
The law contains numerous public health measures and includes a variety of nutrition, physical activity and environmental measures such as the restriction of food marketing to children and adolescents (desarrollando ideas, 2015). The law prohibits the advertisement of HFSS (as defined by specific criteria) foods and beverages to children under 16 years of age via all marketing media (desarrollando ideas, 2015). Further, the law prohibits the use of promotional techniques that are intended to specifically target children, namely, the use of celebrities or characters (animated or real), gifts and prizes, and inappropriate portion sizes (World Cancer Research Fund International, 2017). Further, all food or drinks that are HFSS must be labelled as such. Products containing trans fats must also be labelled with a warning discouraging their consumption (desarrollando ideas, 2015).

**Summary**

As discussed in this section, many countries have implemented regulations or voluntary restrictions on the marketing of HFSS foods to children. Although the regulations introduced in Chile, Brazil and Peru are among the most comprehensive; no country has introduced regulatory legislation that aligns wholly with the recommendations made in the Report of the Commission on Ending Childhood Obesity implementation plan which has been endorsed by the 70th WHA (World Health Organization, 2017).

In their Recommendations from an Expert Consultation on the Marketing of Food and Non-alcoholic Beverages to Children in the Americas, The Pan American Health Organisation (PAHO) recommends the adoption of a broad definition of marketing. Recommendation 8 states that “marketing to children be defined as marketing directed exclusively to children, marketing with a specific appeal to children, and in measured media (television, radio, print and internet media), marketing to which children are exposed” (Pan America Health Organization, 2011, p. 12). Despite these recommendations and those from the World Health
Organization recommending that all places where children gather and spend time be free from all food marketing, there has also been a limited focus on the regulation of outdoor food and beverage advertising.

**Outdoor advertising restrictions**

Outdoor advertising restrictions have been implemented in a few countries and states worldwide. Historically, the development of legislature to restrict outdoor advertising has been to preserve the natural scenery and to improve road safety by limiting environmental distractions, rather than to specifically restrict the content of outdoor advertising and reduce harm from marketing. The following section examines examples of regulatory actions to restrict outdoor advertising.

**Grenoble**

In 2014, the French city of Grenoble banned all outdoor advertising via billboards and signs in favour of creating spaces and opportunities for public expression, and the planting of 50 additional trees to replace former advertising structures (City of Grenoble, 2016). The rationale for this ban was not tied to the achievement of particular public health outcomes but rather to reclaim the city’s identity, to improve the aesthetics of the city, and to provide greater opportunity for citizen expression (City of Grenoble, 2016). The ban also sought to protect children and young people from unnecessary exposure to commercial promotion, noting that children are often the target of advertising and that young children are particularly vulnerable to the effects of advertising (City of Grenoble, 2016). Further, the ban states that the City of Grenoble made a choice not to impose advertising on its residents but to protect its citizens from multinational corporate interests which dominated the outdoor advertising scene (City of Grenoble, 2016). To achieve this ban, the City of Grenoble did not renew its longstanding contract with out of home advertising giant JC Decaux (City of Grenoble, 2016). This contract ended on the 31st of January 2014 and resulted in the removal of 326
outdoor advertisements and a reduction of over 2000m$^2$ of advertising space throughout the city (City of Grenoble, 2016). However, some outdoor advertising remains in Grenoble as the city has an additional contract with JC Decaux which covers all bus stops, tram stops, and other ‘street furniture’ and does not expire until 2019 (City of Grenoble, 2016). At which time, the contract is not expected to be renewed.

São Paulo

Internationally, Sao Paulo was one of the first large cities to introduce comprehensive regulatory measures to reduce the amount of outdoor advertising in the city. The Clean City Law (Lei Cidade Limpa No. 14,233, Sao Paulo, 2006) was approved and implemented in January 2007 by the Sao Paulo City Council. Under Article 9 of the Clean City Law 2006, the ban comprehensively outlaws the placement of advertising in all public outdoor spaces unless specifically authorised. This includes, roads, parks, public squares and other public places, bridges, walkways, viaducts and tunnels as well as their accesses, within 30 meters of public art installations; on riverbeds, streams, lakes and reservoirs, telephone poles, pipelines, traffic poles, fire hydrants, water towers, pay phone booths, street furniture, the walls of all private and public buildings, on motor vehicles, trailers, motorbikes and bicycles (Municipality of Sao Paulo, 2006).

The ban includes advertisements that may not be in public spaces but are visible from the street, and applies to all internally fixed advertisements within 1 meter of any building opening. The ban applies to billboards, signage, posters, flyers and mobile billboards on buses and other transportation (Municipality of Sao Paulo, 2006). The Act stipulates maximum sizes for authorised advertisements; no advertisement can be more than 5 metres in height (Municipality of Sao Paulo, 2006). Exemptions are in place for cultural, education, real estate, and electoral purposes as well as the advertisement of special events (Municipality of Sao Paulo, 2006).
In comparison with the largely self-regulatory approach seen in the regulation of food and beverage advertising in most countries, government organisations regulate and monitor outdoor advertising in Sao Paulo and Grenoble. In Sao Paulo, advertisements are regulated through a licensing and registration process with the Municipal Government of Sao Paulo, while compliance with the law is monitored by the Urban Landscape Protection Commission in combination with other local government departments. Chapter IV of the Clean City Act outlines the administrative procedures for implementing and monitoring the Act with further details for implementation outlined in Decree no 47.950 (December 2006). Fines are imposed for breaches of this comprehensive legislation, approximately $4,097 NZD. For advertisements considered to be an imminent risk to pedestrians, drivers and the general public the fine is issued every 24 hours until the advertisement is removed. For all other advertisements, the fine doubles for every 15 days that it remains in place (Municipality of Sao Paulo, 2006).

The ban was introduced to combat visual pollution and degradation of the built and natural environment within the city (Municipality of Sao Paulo, 2006). The protection and restoration of the cultural, historical, and artistic elements were considered paramount in restoring the architecture of the city, as well as reclaiming public spaces for the public (Municipality of Sao Paulo, 2006). However, the ban was also introduced to protect public safety as outdoor advertisements were cluttering roadways and positioned close to intersections and causing confusion and distraction for motorists looking for addresses or traffic signs and signals at intersections (Municipality of Sao Paulo, 2006). Outdoor advertising was also a major hazard for pedestrians in Sao Paulo as it encroached on footpaths and walkways (Municipality of Sao Paulo, 2006). Before the implementation of the Clean City Law, an estimated 15,000 billboards and 16,000 signs cluttered and polluted the city (Municipality of Sao Paulo, 2006).
The United States

During the 20th century, the states of Vermont, Maine, Alaska, and Hawai‘i all implemented legislation to regulate the amount and placement of outdoor advertisements. The state of Vermont outlawed outdoor advertising in 1968. The ban was introduced to preserve the scenic beauty of Vermont, a major tourist attraction, and the foundation for the state’s economy (State of Vermont, 2012). The ban includes all advertising visible to the travelling public. The regulation was also introduced to reduce hazards and driver distraction near highways and intersections. These regulations also stipulate the size and placement of all signs, including the size of all on premise signs and the distance these can extend (State of Vermont, 2012).

The neighbouring state of Maine introduced a similar ban on billboards in 1977 (updated 2003). Under Maine Title 23, Chapter 15: Protection of highways (2003), billboards, signs, posters or any other notice or advertising feature may not be erected within 33 feet of the centre of the roadway. This regulation was introduced to ensure that highways and intersections are kept clear of visual clutter and to ensure that advertising material does not obstruct directional signs. Similar to the other examples outlined above, the ban on billboards in Maine was introduced to improve safety on major roadways by reducing the potential for driver distractions (Maine Legislature, 2016). However, in contrast to Sao Paulo where large fines are given for infringements, in Maine fines are a minimum of $5 USD with a maximum penalty of $500 USD. However, after ten days the fine increases daily by $50 USD. Maine state police are responsible for removing unlawfully erected signs (Maine Legislature, 2016).

Similar to Vermont, the State of Alaska introduced legislation to prevent the placement of outdoor advertising near all major roadways to preserve the natural beauty of the state and to reduce unnecessary driver distractions or confusion with directional road signs. In Alaska, outdoor advertising may not be erected within 660ft (approximately 200m) of a roadway (Alaska Legislative Council,
Penalties for violation attract fines of between $50 and $5000 USD (Alaska Legislative Council, 2013). In 1966, under HI Rev Stat § 264-72, Hawai’i also implemented a ban on all outdoor advertising visible from highways except directional, real estate, and on-premise signs (Hawai’i State Legislature, 2011). Again, the ban was implemented to improve the safety of those travelling on highways (Hawai’i State Legislature, 2011).

**Canberra**

In the Australian Capital Territory (ACT), billboards are banned on Commonwealth land under the 1937 Roads and Public Places Act. Although the Act was repealed and replaced by the Public Unleased Land Act 2013, freestanding and fixed advertisements are not permitted on or above the first storey of buildings in public places within the ACT. Only ground level advertising is permitted. Exceptions exist for buildings in commercial and industrial areas which are permitted to display advertisements on the first storey (ACT Planning and Land Authority, 2008). Free standing advertising signs are also permitted in industrial and commercial areas but are limited in size to 2m² (ACT Planning and Land Authority, 2008). However, all fixed signs on Territory land are subject to licencing agreements with the Territory. Restrictions on outdoor advertising remain in place in the ACT to preserve the attractiveness and character of the natural and built environments. Retaining an uncluttered and attractive environment within the ACT is particularly important to the Territory as it houses the National Capital and seat of Government of the Commonwealth (ACT Planning and Land Authority, 2008).

**Summary**

In summary, outdoor advertising has been restricted in São Paulo, Grenoble, Vermont, Maine, Alaska, Hawai’i, and the Australian Capital Territory due to its visual impacts and the safety risks it poses for drivers and pedestrians. However,
also Grenoble introduced its ban on outdoor advertising in recognition of the adverse effects of this advertising on its city and to protect children from the harms of commercial promotion. The examples of Grenoble and Sao Paulo provide a framework for how such restrictions could be implemented elsewhere. Further, the examples given from other regions suggest that outdoor advertising is typically regulated in some manner, in most jurisdictions; these existing regulations provide a platform on which additional regulations could be built.

**Regulatory environment for outdoor advertising in New Zealand**

In New Zealand, the erection and placement of outdoor advertising are regulated by local council bylaws and the New Zealand Transport Agency (NZTA) (Signs on State Highways) Bylaw 2010, while the Advertising Standards Authority (ASA) regulates the content of advertising material. However, the ASA is a self-regulated food industry group.

**Central government legislation**

Outdoor advertising on the roadside is a known traffic hazard and has the potential to contribute to traffic accidents by obstructing visibility of traffic signs and signals at intersections, and confusing or distracting drivers if advertisements look similar or detract from official traffic signs (New Zealand Transport Agency, 2001). Further, outdoor advertising provides a visual distraction from the task of driving and, if the advertising forms a physical obstacle on the roadway, has the potential to contribute to traffic accidents (New Zealand Transport Agency, 2001).

To improve road safety, the NZTA developed and introduced the Signs on State Highways Bylaw as national legislation 2010. This bylaw regulates the placement and design of signs on state highways and was introduced to ensure that construction and placement of signs and billboards do not obscure or distract from state highways, motorway or traffic signs (New Zealand Transport Agency,
Consent may be obtained for signs which do not unduly attract the attention of the driver through the use of words, colours or placement (New Zealand Transport Agency, 2010). The Bylaw also stipulates the size, use of colouring, number of words and characters, the materials used in the construction of the sign, banner or billboard, and the proximity of the sign to the roadway (New Zealand Transport Agency, 2010). Consent may also be given so long as the signs do not cause a traffic hazard or in any way compromise the safety of the roadway (New Zealand Transport Agency, 2010). However, the bylaw does not apply to signage and other advertising material constructed behind the kerb line in areas where the speed limit is 50km/hour (New Zealand Transport Agency, 2010).

Local government

District (local) council rules and bylaws regulate the placement of outdoor advertising in New Zealand. Four local government areas: Wellington City, Porirua City, and Lower Hutt City, and Upper Hutt City make up the Wellington region, each with their own council and regulations.

In Wellington city, Standard 13.6.4 of the Wellington City District Plan regulates advertising signs, banners, and billboards. This standard stipulates the maximum height and area of fixed and free standing signs (Wellington City Council, 2000). The placement of fixed signs and billboards on buildings is also restricted to ensure that windows and architectural features are not covered, and the sign does not extend above the highest point of the building (Wellington City Council, 2000). The erection of advertising signs (permanent and temporary) is by application and requires consent from the Wellington City Council (Wellington City Council, 2000).

In Porirua, Part 15 of the Porirua City Council General Bylaw 1991 regulates the placement of billboards and signs. The bylaw was introduced to control the number of signs erected throughout the district and to maintain public spaces that are free of commercial signs which do not relate to a community purpose (Porirua
The bylaw was also introduced to improve road safety, regulate the structural integrity of the signs to ensure the safety of the public, and to introduce a permitting process for those wanting to erect signs within the district (Porirua City Council, 1991). Under this bylaw, all outdoor advertising (including temporary signs) requires a permit from the Porirua City Council (Porirua City Council, 1991).

Section 14B of the City of Lower Hutt District Plan regulates signs and billboards in Lower Hutt City. The District Plan recognises signage within the city as having detrimental effects on the visual amenities of the city, as well as being a potential road safety hazard for the driver, cyclists, and pedestrians (Hutt City Council, 2013). The District Plan cites signs along major entrance routes to the city as providing visual clutter and undermining a sense of place for city residents (Hutt City Council, 2013). Temporary signs are also identified as an issue as their appearance is often of a lower standard than commercially produced signs, and they may obstruct footpaths and cycleways (Hutt City Council, 2013). The District Plan also contains different restrictions on the height, size (sign area) and content dependent on the area. The restrictions differ depending on whether the area is residential, rural, a recreation area, a community health activity area (e.g., around Hutt Hospital), or community and Iwi activity centre (Hutt City Council, 2013). They also differ for commercial businesses or if in a commercial business area where signs are within 50 meters of the state highway or where signage is visible from the state highway (Hutt City Council, 2013). The erection of advertising signs is by application and requires council approval (Hutt City Council, 2013).

In Upper Hutt City, outdoor advertising is regulated by the city council under the Control of Advertising Signs Bylaw 2005 and requires council approval before it can be erected (Upper Hutt City Council, 2017). All signs erected within the district of Upper Hutt City Council are also regulated under Chapter 21: Open Space Zone Rules of the Upper Hutt City Council District Plan 2004 (Upper Hutt
City Council, 2004). This bylaw and the rules outlined in the District Plan regulate the size, number, and placement of all temporary or permanent signs, posters, and billboards within Upper Hutt City. As with the other City Councils across the region, these regulations were introduced to improve road safety and to mitigate the detrimental visual impacts of signs on the outdoor environment (Upper Hutt City Council, 2004).

The content of outdoor food advertisements is not currently regulated by local councils. However, the councils do regulate the content of outdoor signs and advertisements. For example, local government control the placement of signs advertising commercial sex activities and services (Upper Hutt City Council, 2017; Wellington City Council, 2000). Further, the Upper Hutt City Council does not allow signs that are discriminatory or that advocate discrimination, those that are insulting, offensive or threatening, nor those that encourage or provoke a person to commit an offence (Hutt City Council, 2013).

**Advertising Standards Association**

The content of all advertising material in New Zealand is monitored by the Advertising Standards Association (ASA) according to its code of ethics. The ASA is a self-regulatory body that represents an alliance of advertisers, their advertising agencies, and the media (Advertising Standards Authority, 2017b). During the time the Kids’Cam study was conducted (July 2014-July 2015), the code of ethics contained two codes of particular interest, the Children’s Code for Advertising Food, and the Code for Advertising to Children. The Code for Advertising to Children covered all forms of media that may influence children irrespective of whether they may be classed as children’s media. The New Zealand Television Broadcasters code “Getting it Right for Children” also applies to all child-targeted advertising through broadcast media channels.

The Children’s Code for Advertising Food applied to children under the age of 14 years and stated that “food advertisements should not undermine the food and
nutrition policies of the government, the Ministry of Health Food and Nutrition Guidelines nor the health and well-being of children" (ASA, 2014 p.21). The code noted that advertising of food to children should not undermine parental efforts to educate their children about healthy eating, and that the promotion of treat foods, snacks and fast food should not encourage excess repeated consumption or promote excessive serving sizes. The code also advised advertisers that care should be taken in the use of competitions, premiums and loyalty programmes when advertising high fat, salt, and sugar foods to children to ensure that advertising does not encourage frequent and repeated consumption of these products.

Although the code was comprehensive in its recognition of the many marketing strategies used to target children and encouraged advertisers to adhere to the code, compliance with this code was voluntary. Further, the code did not contain specific details of the appropriate portion sizes for children under the age of 14 years, nor did it employ a nutrient profiling model to classify foods and beverages as high fat, salt and sugar. What is more, compliance with the code was not monitored by an independent body and instead relied on a complaints process whereby members of the public could make complaints about a specific advertisement and were required to state which code had been breached. The complaints process was not conducted by an independent agency; as such the ASA had the power to dismiss complaints without taking further action. Further, there was no imposed penalty for a breach of the code. The codes did little to protect children from the persuasive influence of food marketing.

In October 2015, the Ministry of Health released its Childhood Obesity Plan. Under this plan, the ASA was encouraged to conduct a review of its advertising codes for children. As part of the review process, submissions on the strengths and limitations of the existing code were sought from government and non-government organisations, health organisations, advertisers, media and other industry groups. Submissions were also open to the public. A panel of health sector and food and advertising industry representatives reviewed the existing
The ASA developed the new code taking into account issues raised in panel discussions and the 92 submissions from groups and individuals (Advertising Standards Authority, 2016). The Report on the Review of the Children’s Code for Advertising Food and the Code Advertising to Children was released in September 2016. Following this review, the Children and Young People’s Advertising Code came into effect on 3 July 2017 and applies to all new advertisements. The code came into effect for existing advertisements on 2 October 2017 and replaces the Children’s Code for Advertising Food and the Code for Advertising to children.

However, there are few differences between the old codes and the new combined code (Swinburn et al., 2017). The new code only applies to advertisements that are specifically targeted to children and young people. Further, the code only applies to ‘occasional’ foods advertised in media where children are likely to constitute at least 25% of the audience (Advertising Standards Authority, 2017c). However, the new code does not apply to all marketing media; for example it excludes product packaging, which is an important source of children’s food marketing exposure (Signal, Stanley, et al., 2017; Swinburn et al., 2017).

Under the new code, the Ministry of Health’s Food and Beverage Classification System (FBCS) was selected to classify foods as those recommended for consumption by children every day, sometimes, and occasionally. However, as this nutrient profiling model was designed to classify foods sold in school canteens it will need considerable modification to be fit for purpose (Swinburn et al., 2017). Recent New Zealand research assessed the feasibility of using three different nutrient profiling models (NPMs) to restrict food marketing to children including the FBCS, the Health Star Rating System (HSRS) (currently used to provide interpretive nutrition information on front of pack labels), and the World Health Organization Regional Office for Europe NPM (WHO NPM) (Ni Mhurchu et al., 2016). Each of the NPMs was applied to assess 13,066 packaged food products. Overall, the FBCS would permit 39% of all products to be marketed to children compared with 36% under the HSRS and 29% under the WHO NPM. Notably, the WHO NPM would permit only 33.5% of New Zealand breakfast cereals to be
marketed to children compared with 75% under the FBCS. Further, the FBCS would permit 83% of convenience foods and 61% of dairy products to be marketed to children, compared with 34% and 14% respectively under the WHO NPM. The findings of this research suggest that the WHO NPM system is more effective in restricting unhealthy food marketing to children than the FBCS (Ni Mhurchu et al., 2016). Therefore, the introduction of the FBCS, while a positive addition to the new Children and Young People’s Advertising Code, may not adequately restrict the marketing of HFSS foods to children.

Rule 1(i) of the new code states that advertisements for occasional food or beverage products must not target children or be placed in any media where children are likely to be a significant proportion of the expected average audience, including “locations where children gather (e.g. schools, school grounds, pre-school centres, playgrounds family and child clinics and pediatric services and during any children’s sporting and cultural events) (Children and Young People’s Advertising Code and Guidance Notes, 2017, p.5).” Although a number of examples are listed, this is not an exclusive list of the places children and young people gather, and the full extent of the settings to which the code applies is ambiguous (Swinburn et al., 2017). However, the code does not appear to apply to outdoor advertising. Further, the new code remains voluntary and self-regulated, and, in its current form, it is not expected to be effective in reducing children’s exposure to food advertising (Swinburn et al., 2017).

Internationally, many food manufacturers have responded to the threat of government regulation of unhealthy food and beverage marketing by introducing voluntary pledges and self-regulatory codes on food marketing to children. However, systematic reviews of the impact on these voluntary and self-regulated codes suggest that these measures have had little or no impact on children’s exposure to unhealthy food marketing where they have been introduced, and children’s exposure to unhealthy food advertising remains high (Galbraith-Emami & Lobstein, 2013; Ronit & Jensen, 2014). Further, self-regulatory measures typically lack a comprehensive definition of marketing, apply to a narrow range of
media, and lack enforceability and penalties for breaches (Galbraith-Emami & Lobstein, 2013). As such, statutory regulations have been recommended in favour of self-regulatory approaches by the WHO, the WHA, and health experts (Galbraith-Emami & Lobstein, 2013; Swinburn et al., 2017; World Health Organization, 2017).

Summary

In New Zealand, The New Zealand Transport Agency (Signs on State Highways) Bylaw 2010 and local government bylaws regulate the construction and placement of outdoor advertising, while the industry body, the ASA, regulates the content of outdoor food and beverage advertisements. However, the ASA code is voluntary, self-regulated and there are no penalties for breaches. Further, evidence suggests that the new ASA code will do little to reduce children’s exposure to unhealthy food marketing. The content of outdoor food and beverage advertising is not currently regulated by law in New Zealand, despite evidence that it contributes to children’s overall exposure to food marketing and recommendations from the WHO and WHA to reduce children’s exposure to such marketing (World Health Organization, 2017). Further, the wording of current recommendations on the marketing of food and non-alcoholic beverage to children may be interpreted narrowly, confining the places where children gather to those institutions designed for them, rather than all of the places children spend time.

Children’s neighbourhoods and places

To date, research on food marketing to children has focused on three key locations: the home, school, and the immediate geographical areas around both. However, as presented in the previous section, food advertising is not limited to these locations and, by extension, neither is children’s exposure to food advertising. Children gather and spend time in a variety of different environments
during a typical day, all of which contribute to their development and well-being. Oldenburg & Brissett (1982) provide a useful framework for conceptualising important environments in the lives of adults and children alike in their discussion of “the third place”. Using this framework, the authors identify three key settings, the home (first place), workplace (second place), and the public places that exist outside of the home and workplace (third places) (Oldenburg & Brissett, 1982).

Third places are key sites for public life including main streets, parks, local shops, cafes and restaurants and small businesses (Gardner, 2011). Physically, third places are often ordinary (Gardner, 2011). However, they provide a neutral ground for social interaction and are accessible to all members of the public (Gardner, 2011). They can be divided into destinations or transitory zones. Third place destinations include parks and other outdoor areas, libraries and other community centres, and shopping areas (Gardner, 2011). Transitory zones are those that are passed through on the way to destinations, such as roads and footpaths, but are also third place destinations themselves (Oldenburg & Brissett, 1982). These places are important spaces that provide opportunities for social interaction, leisure, and informal play (Oldenburg & Brissett, 1982). Although conceptualised as public places and places where the public may freely gather, shopping malls, cafes, and restaurants are typically private places into which the public are invited but that are controlled by businesses.

Public spaces are important to children. They provide opportunities for physical activity, social interaction and independent mobility, and the development of a sense of place and personal identity (Carroll, Witten, Kearns, et al., 2015). Use of public spaces contributes to children’s social, psychological and spatial development, providing opportunities for engagement with neighbours, friends, and members of the public (Tranter & Pawson, 2001). Public spaces also provide an opportunity for children to observe the social interaction between others and to observe and learn about their environment more broadly (Carroll, Witten, Kearns, et al., 2015).
Where children gather

Children gather and spend time in third places. Findings from the Auckland (NZ) based Kids in the City study indicate that inner-city and suburban children spend time in third place destinations (Carroll, Witten, Kearns, et al., 2015). The study included 100 children from suburban neighbourhoods and 40 from inner-city neighbourhoods in Auckland. Walking interviews were conducted with each of the 140 children whereby a trained interviewer accompanied the children in a walk around their neighbourhood. During the interviews, children were asked what they liked and disliked about their neighbourhoods, discussed their safety concerns and what suggestions they had from making their neighbourhoods more child friendly. Follow up focus group discussions were also held with the children to discuss their experience and perceptions of their neighbourhoods. Children reported spending time at shopping centres with friends, walking around and window shopping and also enjoyed spending their time at local bakeries, dairies and other food outlets. Local parks were important to the children, providing opportunities for formal and informal sporting practice and activities, and space for other active free-play activities. Similarly, quieter parks were valued by children as they provided a space to relax and have some downtime. Other local facilities including libraries, churches, community and youth centres were also viewed as important third place destinations by children (Carroll, Witten, Kearns, et al., 2015).

In an Australian study, 78 Melbourne parents were interviewed about the places their children usually played (Veitch et al., 2006). Over one-third reported that their children usually engaged in active free-play in the street, while a similar number reported that their children often played in local parks and playgrounds and bush and river areas (Veitch et al., 2006). However, the home was still the most common site of children’s active free-play (74%) (Veitch et al., 2006). Children also played on the school grounds outside of school hours and visited swimming pools (Veitch et al., 2006). Interestingly, parents reported that school
grounds and swimming pools were not typical places of children’s play (Veitch et al., 2006). However, it is worth noting that parents were interviewed rather than the children, themselves.

In a Dunedin (NZ) study of 92 children (9-11 years), participants most commonly played in local parks/reserves, at school and in the streets around their homes when they were not playing at home (Freeman, 2010). These findings are supported by those from a study of children’s experience of public space in Edinburgh (Elsley, 2004). When asked what they like about their local area, children identified places that had been designed with their use in mind, such as a local swimming pool and recreation centre, parks and an all-weather football pitch. However, the children also valued and favoured the informal areas that they frequently used for recreation and socialising. Such places included, local streets and a nearby shopping complex, as well as forests, fields, and building ruins located on the outskirts of town (Elsley, 2004).

Children also spend time playing and gathering on the street, which can be conceptualised as both a transitory third place and a destination (Carroll, Witten, Kearns, et al., 2015). Adults often view the street and the accompanying thresholds (driveways, porches, backyards and balconies) as transitory places. However, for children, these places provide important and valued spaces for recreation and social interaction (Carroll, Witten, Kearns, et al., 2015; Elsley, 2004). The findings from New Zealand research, Kids in the City, suggest that children do not view these transitory third places as thoroughfares, but rather places that form an important part of their environment with which they interact daily (Carroll, Witten, Kearns, et al., 2015). The street provided numerous opportunities for children to play and interact with each other.

Many children spoke of enjoying walking (or scootering) to school and other destinations. The street was more than just a thoroughfare, providing many opportunities for play: children jumped on walls, balanced on kerbs and avoided stepping on cracks; they ran, skipped and spun in circles; and they played various games incorporating manhole covers, shadows, and other
street features...Streets provided opportunities to ‘walk and talk’ with friends, to look at people, gardens, graffiti, shop displays and cafes. There was also somewhere children could scooter, skate, run or bike; and on quiet suburban streets play ball games with friends and use kerbs and bumps to do skateboard and scooter tricks (Carroll et al. 2015. p. 428).

A study of 10 to 16 year-olds in a socially deprived area in Northamptonshire, England, also investigated the way that children and young people used the street (Matthews, 2003). A combination of questionnaires, semi-structured interviews and focus groups were used to investigate how 140 children used the streets in their neighbourhoods. Children reportedly viewed the street as an important environment that provided opportunities for social interaction, adventures, and recreation. Children most commonly used the street for informal games of football and cricket, skateboarding, cycling, rollerblading, meeting and talking with friends, free play, and as a means of ‘getting away from it all’ (Matthews, 2003). The street was also an important meeting place for children to maintain social ties outside of school hours and during school holidays as almost half (48%) of children never or rarely had friends over to visit. Unlike adults who have the option of socialising at pubs, bars, restaurants, sports clubs and other recreational facilities at their whim, children are restricted in their access to such settings as they often require the company of adults to and/or at these locations (Matthews, 2003). The street is one of the few settings in which children can meet informally to socialise and play. Matthews (2003 p. 106) argues that streets are places where,

adultist conventions and moralities about what it is to be a child – that is, less-than-adult can be put aside. They are spaces that are temporarily outside of adult society...Yet here is a cultural dilemma, for whilst streets appear to offer freedom away from adult mores, occupancy of the public domain is rarely uncontested, particularly when young people come into contact with vigilant adults who are not prepared to relinquish their overarching control.”
Despite the increasing recognition of children as autonomous individuals, adults continue to decide the environments that have the greatest significance for children (Matthews & Limb, 1999; Witten et al., 2015). As discussed above, children view third place destinations and transitory zones as important places. Although children’s needs are considered increasingly in urban planning and policy development, most third places are still widely conceptualised as features of the adult world, rather than an intersection point between the worlds of adults and children (Freeman & Aitken-Rose, 2005; Matthews & Limb, 1999; Tranter & Pawson, 2001). Adults often conceptualise children’s places as those that are designated and designed specifically for their use (Rasmussen, 2004). Rasmussen (2004) labels this concept the institutionalised triangle, within which, the corners are represented by the home, school and the recreational facilities designed for children (Rasmussen, 2004). However, these ‘places for children’ are not the only settings where children gather and are not the only places that are important to children, as discussed above.

Using outdoor food advertising as an example, limiting the conceptualisation of children’s places to those viewed as children’s places by adults justifies the placement of advertising in places where children will encounter it. This occurs as adults largely view the street as an adult environment rather than a shared environment. Places for children have narrowly been conceptualised in the urban planning literature as child-serving institutions, recreation facilities and the home (Carroll, Witten, Kearns, et al., 2015; Rasmussen, 2004). Further, parental and societal fears for children’s safety in public places has in part led to the sequestering of children from public places into those seen as more suitable places for them to gather such as the home, school, and public places specifically designed for their use such as playgrounds. Matthews et al. (1999) argue that outside of these child-allocated spaces children are simply required to fit into the environments of the adult world.
Summary

Although streets, shopping areas and other features of the cityscape are not typically viewed as places for children or children’s places, clearly they are important settings in which children live their lives. However, measuring children’s exposure to food advertising in each of their everyday environments poses a methodological challenge. The following section briefly reviews previously used methods of measuring outdoor food marketing and explores an alternative method of documenting children’s worlds.

Measuring food marketing in the outdoor environment

Food advertising in the outdoor environment has been understudied and little is known about the extent of children’s exposure to this, and food and beverage marketing in the wider community in which children live (Pasch & Poulos, 2013). Furthermore, few studies have linked exposure to food marketing in the outdoor environment with a health-related outcome measure such as BMI (Pasch & Poulos, 2013). This section discusses previously used methods of assessing outdoor food marketing, and their strengths and limitations. Alternative observational methods and tools are also discussed.

Observational methods used to measure outdoor food marketing

Outdoor food advertising is commonly measured using cross-sectional observational studies employing purpose developed environmental survey tools (Adams et al., 2011; Gebauer & Laska, 2011; Isgor et al., 2016; Settle et al., 2014). Estimating children’s exposure to outdoor food marketing typically involves the researcher recording all visible marketing within a defined geographical area that is assumed to represent the child’s neighbourhood. For example, in their study of unhealthy outdoor advertising in three US cities, Hillier et al. (2009) used digital cameras and global positioning system (GPS) devices to collect data on the size,
content and location of outdoor food advertisements within a 300m, 450m and 600m radius of all child-serving institutions. A GPS device was used to measure the latitude and longitude of each advertisement (Hillier et al., 2009). Using these methods allowed for quantification of the extent and content of the advertisements, and allowed for comparison between three cities with different bylaws for outdoor advertisements (Hillier et al., 2009). However, the use of these methods did not allow for an estimate of exposure to this advertising.

Similar methods were used in Newcastle (UK) to identify all outdoor advertisements along bus routes and around shops within the Newcastle city boundaries (Adams et al., 2011). Over a two month period (October – December), the authors took photographs of all outdoor food advertisements within city boundaries, estimated their size, and recorded their location using a GPS device (Adams et al., 2011). Advertised food products were also recorded and categorised into one of six food groups corresponding to the UK Food Standards Agency ‘eat well plate’ (Adams et al., 2011). An area-based measure of deprivation (English Index of Multiple Deprivation (IMD) 2007) was also assigned to each advertisement based on its geographical location (determined by GPS) (Adams et al., 2011). Again, these methods did not allow for any estimation of exposure to the marketing in the outdoor environment. The use of GPS data in this way enabled researchers to determine the number of food advertisements in the most affluent, middle, and least affluent areas (Adams et al., 2011). However, this study was conducted over a short period, close to Christmas. The inclusion of the period leading up to Christmas may mean that the results do not accurately reflect the type or amount of outdoor food advertising present during other times of the year (Adams et al., 2011).

Similar methods were employed by Kelly et al. (2015) in their study of the density of outdoor food and beverage advertising around schools in Mongolia and the Philippines (Kelly, King, et al., 2015). Researchers collected information on all food and beverage advertising within a 250m and 500m radius of each school,
including the location, setting, size, type of product advertised and position of the advertisement (Kelly, King, et al., 2015). Food and beverage products were then categorised as either core (healthy), non-core (unhealthy) or miscellaneous (Kelly, King, et al., 2015). The density of food advertisements within both radii was determined and reported in the number of advertisements per 100m² (Kelly, King, et al., 2015).

As in previous studies, a purpose-developed audit tool was also used to determine the prevalence and type of outdoor food advertisements at bus stops, and train and tram stops across 20 socio-economically diverse suburbs in Melbourne, Australia (Settle et al., 2014). In this cross-sectional study, all transit stops with a shelter within the 20 suburbs were identified and the location and type of food advertising recorded (Settle et al., 2014). The advertised foods were then categorised into one of the following eight groups: cold beverage, hot beverage, snack food, fast food, cereal, dairy, fruit and vegetables, and other food (Settle et al., 2014). The authors analysed the data by the specific food item and area-level deprivation, and performed a comparative analysis between the least and the most disadvantaged areas (Settle et al., 2014). In this study, only one researcher collected the data. However, the audit tool had been piloted previously with input and oversight from all authors to determine the reliability and accuracy of the tool (Settle et al., 2014). A key limitation of this study is the focus on public transit stops rather than encompassing outdoor food advertising in other settings. Further, these methods alone could not be used to estimate resident’s exposure to this advertising. However, the study locations were chosen as they are visited by large numbers of people daily (Settle et al., 2014).

Comparatively, one New Zealand study used a combination of methods to estimate children’s exposure to food marketing in the area surrounding schools (Walton et al., 2009). In this study, all food outlets and outdoor food advertisements within a 2km buffer zone around each of four New Zealand primary schools were recorded. A GPS device was used to record the coordinates
of each food outlet and outdoor advertisement, and a digital photograph was taken at each of these sites. Using geographic information systems, the number of food outlets and outdoor food advertisements within the 2km buffer were mapped. Researchers then used the residential address of each participant to calculate the number of outlets and outdoor food advertisements each participant passed on their journey to school (Walton et al., 2009). However, the route used to calculate the latter assumed that children took the most direct route when travelling to and from school. Information on the actual route taken was not collected. Further, one of the four schools within the sample attracted students from a wide geographical area, exceeding the 2km buffer area, leading to a possible underestimate of exposure to food advertisements for those students (Walton et al., 2009).

Researchers in the US have used similar methods to investigate the association between outdoor advertising and overweight and obesity in the resident population (Lesser et al., 2013). A systematic cross-sectional survey of 114 census tracts in both Los Angeles County and Louisiana was conducted to identify and record all outdoor food advertising, its size, advertising medium and location. Similar to the previous studies, a GPS device was used to record the latitude and longitude of each advertisement. A standardised coding schedule was also used to record and categorise advertisements as food or restaurants, alcohol, tobacco, or other (Lesser et al., 2013). However, assumptions were made about the level of exposure of respondents to advertising in their neighbourhood and did not take into account their exposure to outdoor advertising outside their neighbourhood. Such exposures may include those advertisements seen on the commute to and from work or during any time spent outside of their neighbourhood. Therefore, the associations between obesity in the resident population and the presence of outdoor advertising and within a census tract may be mediated by resident’s exposures to outdoor advertising outside of their resident census tract.
Many of the previous studies have used buffer zones, typically a radius of 400-1600 meters around the home or a buffer zone of up to one kilometre around the child’s school (Maher et al., 2005; Villanueva et al., 2012). However, research suggests that these buffer zones may not be an accurate representation of children’s neighbourhoods as some children may travel further afield to attend school or other activities (Villanueva et al., 2012). There is a need for an objective measure both of children’s exposure to this marketing, and also for an objective measure of children’s neighbourhood environments.

Although these methods have been used to objectively describe the extent and nature of food advertising in parts of the outdoor environment, they cannot be used to accurately quantify the number of advertisements that children are exposed to throughout their day. Further, most previous studies of outdoor food advertising in children’s environments have focussed on the area immediately around schools or other places designed for children, and have not attempted to assess all of the outdoor food marketing that children encounter in the wider outdoor environment in which they live and spend time. A possible explanation for this is the difficulty and time associated with determining where children go and spend their time, and then assessing each distinct setting for outdoor food advertising. Therefore, alternative methodological approaches to determining children’s exposure to outdoor food advertising are needed. Possible alternative methods of assessing children’s exposure to food and beverage advertising in outdoor settings are discussed in the following sections.

**Participant observation**

Participant observation would be an alternative method of estimating children’s exposure to food marketing. Participant observation involves the researcher observing and recording participant behaviour in a particular setting while also being immersed in that same setting (Bryman, 2012). The main advantage of this method is that the observations take place in the participant’s natural setting and
may produce data that accurately reflects the participants’ behaviour or environment (Bryman, 2012). However, traditional methods of participant observation can be highly intrusive and disruptive to daily life for the participant (Bryman, 2012). Further, the presence of the observer may cause changes in the participants’ behaviour in which case the observations may not be indicative of the participant’s usual behaviour (Bryman, 2012). Participant observation can also be time and resource intensive owing to the continual presence of the researcher (Bryman, 2012). As such, it would be impractical to continually observe a large sample of children to collect information on their exposure to outdoor food marketing throughout their day in all of the settings they go to.

**Wearable cameras**

Wearable cameras may provide an alternative to traditional methods of observation. These devices may be less invasive and more time efficient than traditional observational methods as the researcher’s presence is not required during the data collection period (Raento et al., 2009). Using this technology may also reduce the costs associated with long-term participant observation (Raento et al., 2009). Additionally, the collected data may accurately reflect the wearers’ exposure to the phenomena of interest in their environments, improving the ecological validity of the results (Bryman, 2012; Raento et al., 2009; Shiffman et al., 2008). Furthermore, the use of multiple wearable cameras would allow multiple participants to collect observational data simultaneously, reducing the onus on the researcher during data collection (Raento et al., 2009).

In recent years, the use of wearable cameras has become increasingly common in physical activity and behavioural nutrition research. One such camera, SenseCam, has been used successfully as an objective observational tool to measure active and sedentary behaviours among adults in free-living settings (Doherty et al., 2012; Doherty, Kelly, et al., 2013; Kerr et al., 2013). SenseCam has also been used to measure active and passive transport in adults and young people during their
commute to and from their workplace or school (Doherty, Kelly, et al., 2013; Kelly et al., 2012; Oliver et al., 2013). Research in which participants wore both a SenseCam and an accelerometer, demonstrated the value of using a wearable camera as the SenseCam was able to provide objective information on the type of activity captured by the accelerometer. Data collected using the SenseCam also allowed the researchers to differentiate between sitting and standing activities that fell below the threshold for activity using the accelerometer but have important implications for health (Kerr et al., 2013). The use of wearable cameras in physical activity research is particularly useful as it allows for the simultaneous collection of information on the type of activity and the context in which it occurs, a key advantage over traditional measures (Doherty et al., 2012).

SenseCam has also been used to document food advertising in children’s environments in a feasibility study conducted in Wellington, New Zealand (Barr et al., 2015). During this study, six children (aged 12 years) wore the SenseCam device for two days. The data were then downloaded and reviewed to identify and quantify the food marketing that appeared in the images (Barr et al., 2015). The authors reported that wearable cameras were an effective tool for capturing food marketing across the spectrum of children’s everyday environments (Barr et al., 2015).

**Strengths and limitations of using wearable cameras**

Wearable cameras have many advantages over traditional research methods. They provide a tool for direct observation, reducing the impact of self-report bias and social desirability bias inherent in traditional research methods (Doherty, Hodges, et al., 2013; Gemming et al., 2015; O’Loughlin et al., 2013). Wearable cameras also collect information on the context in which an exposure or behaviour was occurring (Doherty, Hodges, et al., 2013).

Although wearable cameras are a promising and novel observational tool, there are reported limitations of using these devices. Widely reported issues with wearable cameras include: poor quality images taken in low light; limited battery
life; sporadic camera function; and the collection and analysis of the large image
data set produced (Barr et al., 2015; Kelly, Doherty, et al., 2011; Kelly et al., 2012; Oliver et al., 2013). There are also ethical and legal concerns regarding the use of wearable cameras in research settings. The legal issues are related to the legality of taking images in the study location and the capture of third parties in the images. Further, the privacy and anonymity of the participants and the captured third parties are issues that must be addressed in applications to relevant boards governing ethical conduct (Barr et al., 2013; Kelly et al., 2013). However, these issues can be addressed by adherence to an ethical framework such as that proposed by Kelly et al. (2013), and the development of rigorous study protocol and data handling procedures.

**Summary**

Overall, previously used methods of documenting outdoor food advertising are effective in describing the extent and nature of food outdoor food advertising in a particular location. However, these methods cannot be used to estimate children’s exposure to this advertising. The literature suggests that wearable cameras may provide an effective alternative for documenting children’s exposure to outdoor food advertising across the spectrum of their everyday environments.

**Chapter summary**

In summary, outdoor advertising is an effective and widely used medium of advertising food and beverage products, and may contribute significantly to children's exposure to unhealthy food and beverage marketing (Bhargava & Donthu, 1999; Kelly, Cretikos, et al., 2008; Taylor et al., 2006). The evidence suggests that the majority of outdoor food advertisements are for products that are high energy, fat, salt and sugar (Chacon et al., 2015; Gebauer & Laska, 2011; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005). Such advertisements are commonly found in close proximity to schools, along major
roadways, at public transport stops, and on the exterior of food retail outlets (Adams et al., 2011; Isgor et al., 2016; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Powell et al., 2012; Settle et al., 2014). Much of the research to date has been confined to these settings and the extent of children’s exposure to outdoor food advertising in places outside of the home, school, and retail environments remains largely unexplored. However, the literature suggests that main streets and other public places are important environments in which children gather and spend time (Carroll, Witten, Kearns, et al., 2015; Elsley, 2004; Veitch et al., 2006).

To reduce children’s exposure to food marketing, a number of countries have implemented regulations or voluntary restrictions on the marketing of HFSS foods (World Cancer Research Fund International, 2017). Promisingly, Brazil and Peru have introduced comprehensive restrictions on food marketing to children via all marketing media. In practice, these restrictions have been difficult to implement thus far, and no country has introduced legislation that aligns wholly with the WHO recommendations on the marketing of food and non-alcoholic beverages to children (Kraak et al., 2016). However, outdoor advertising restrictions have been successfully implemented in major cities, worldwide. The cities of Grenoble and Sao Paulo have banned outdoor advertising as it is visual pollution, contributes to the commercialisation of public space and exposes children to unnecessary commercial promotions (City of Grenoble, 2016; Municipality of Sao Paulo, 2006).

The literature reviewed in this chapter suggests that many major cities have existing legislation that regulates the placement or erection of outdoor advertising. In New Zealand, this occurs at the local government level. However, there are no current restrictions on the content of outdoor food advertising in New Zealand, only those that apply to the physical placement of the advertisements. In New Zealand, further research is needed to document children’s exposure to outdoor food advertising to identify key targets for intervention. However, previous methods of documenting outdoor food advertising do not allow for the estimation of exposure to this advertising.
Wearable cameras may be an effective tool for documenting children’s exposure to outdoor food advertising across the spectrum of their everyday environments.

The following chapter outlines the development of the methodological approach employed in this thesis to investigate the extent and nature of children’s exposure to outdoor food advertising. Specifically, to investigate the extent and nature of children’s exposure to non-core and core outdoor food advertising and how this varies by ethnicity, school decile, BMI category, and gender.
Chapter Four: Kids’Cam study set up

This chapter outlines the development of the Kids’Cam study, the study methods and protocols, and my role in their development. Chapter Five provides further details of the methods used in Kids’Cam and to answer the research questions specific to this thesis. Chapter Four begins with a restatement of the Kids’Cam research questions and those specific to this thesis, then gives the definition of food marketing and outdoor advertising used in this work. Details of the early stages of the Kids’Cam study including those of the 2012 feasibility study, preparation for the Kids’Cam project, and the 2014 pilot study are then given. A brief evaluation of the pilot study is then presented alongside details of changes made to study protocols following the pilot study.

Kids’Cam research aims

Kids’Cam aimed to examine the frequency and nature of children’s everyday exposure to food and non-alcoholic beverage marketing across multiple marketing media and settings, and to explore ethnic, socioeconomic and gender differences in these exposures. Differences in food marketing exposure by children’s BMI were also examined.

Kids’Cam study overview

To investigate this, a cross-sectional observational study design was implemented. The study was conducted with a sample of Year 8 children recruited from randomly selected primary and intermediate schools in the Wellington region. To account for regional differences in food marketing environments, children were recruited from schools from across the region. Participating children wore a camera that captured a 136° first person point-of-view image every 7 seconds and a GPS device during all waking hours for four days, being two week days and two
weekend days. Children wore the GPS device so that the geographical location of food marketing could be determined. Following the four-day data collection period, participants attended a session where they reviewed their images and had the opportunity to delete anything they did not wish the researchers to see. At this time they also had their heights and weights measured to determine their age and gender-specific BMI. Participant images were then uploaded to a server computer, for coding. All images were coded manually using bespoke computer software developed by collaborating researchers at Dublin City University (DCU). The codes were then collated and used in statistical analyses to determine the mean rates of children’s daily exposure to non-core and core food marketing by setting, marketing medium and according the food product category of the food products identified in the images. Analyses to determine ethnic and socioeconomic differences in this marketing were also performed.

**Thesis research questions**

As part of the wider Kids’Cam study, this thesis aimed to determine the extent and nature of children’s exposure to outdoor food and non-alcoholic beverage advertising (hereafter food advertising). The Kids’Cam study design was employed to answer the following central research question:

What is the extent and nature of children’s exposure to outdoor food and beverage advertising?

And the following sub research questions:

1. What is the extent and nature of children’s exposure to non-core and core outdoor food advertising?
   a) How does this vary by ethnicity, school decile, BMI category, and gender?

2. What is the extent and nature of children’s exposure to non-core and core outdoor food advertising on their journeys to or from school?
a) How does this vary by ethnicity, school decile, BMI category, and gender?

3. What are the most frequently advertised non-core food product categories that children are exposed to:
   a) In all outdoor settings, and
   b) On the journey to or from school?

**Defining food marketing**

Marketing has been defined in numerous ways. This work adopts a WHO definition of food and beverage marketing which characterises marketing as

Any form of commercial communication or message that is designed to, or has the effect of, increasing the recognition, appeal and/or consumption of particular products and services. It comprises anything that acts to advertise or otherwise promote a product or service (World Health Organization, 2012 p.9).

Further, this definition asserts that

Marketing is an economic activity in which an organization promotes their goods or services in return for remuneration or other form of consideration. They can do so, for example, through:

- paying for advertising (e.g. buying advertising space on a television channel);
- product placement (e.g. paying for a branded product to be used in a movie);
- sponsorship (e.g. paying for a programme or sports event in schools);
- self-promotional means (e.g. via an organization’s own website, sales promotions in shops, or attractive devices, messages or images used with, on, or in the products themselves) (World Health Organization, 2012, p.9).
Defining outdoor advertising

For this thesis, the definition of outdoor advertising includes the above definition of marketing but is limited to marketing messages displayed in outdoor areas via the following marketing media: billboards, posters, stickers, free-standing signs, banners, painting on walls, and flags outside stores (Chacon et al., 2015).

The following sections provide details of the early stages of the Kids’Cam project. Beginning with the feasibility study conducted in 2012, the successful Health Research Council funding grant application and the pilot study for Kids’Cam conducted in 2014.

Using wearable cameras to capture children’s exposure to food marketing: a feasibility study

In 2012, under the supervision of LS, GJ, and MS, I conducted a proof of concept study to investigate the feasibility of using wearable cameras to capture children’s exposure to food marketing. I conducted the feasibility study as part of my dissertation for a Master of Public Health at the University of Otago, Wellington. The feasibility study was conducted using SenseCam as it was the best, readily available, wearable camera technology at the time. The SenseCam automatically captured a time-stamped image approximately once every 10-20 seconds. Using a sequential mixed-methods approach, the feasibility of the technology and the purpose-developed methods were assessed using the following criteria:

- Was it feasible from an ethical and legal perspective?
- Could the technology and methods be used effectively to provide data that could be readily analysed to determine children’s exposure to food marketing?
- Was it an acceptable method of data collection from the participants’ perspectives?
Feasibility study ethical approval

An application for ethical approval was drafted by MB with input from LS, MS and GJ, and was presented to the University of Otago Human Ethics Committee. The key ethical issues identified were the legality of recording images in public places; the potential to capture images of illegal activity that the wearer is witnessing or participating in; third-party consent to be photographed; parental consent; ownership of participant-generated images; data handling and storage; privacy and anonymity of participants and third parties; and participant safety (Barr et al., 2015). Protocols for the management of these issues were developed and included in the application for ethical approval. The protocols included ensuring the provision of information to participants, requiring informed consent from participants, their parents and the participating school; and the development of protocols for data collection and data handling to protect the privacy, confidentiality and anonymity of participants and third parties captured in the images (Barr et al., 2015).

Further, legal advice was sought from an Associate Professor within the Faculty of Law at the University of Otago on the responsibilities of the researcher, should the images contain what appeared to be an illegal act. The advice suggested that it is unlikely that the camera device would be worn during illegal activity and that the captured images would not be able to provide sufficient context for the activity due to the 10-second delay between image capture. Further, as children were given the option of reviewing and deleting images, it is unlikely that these would be passed onto the researcher. The time delay between image capture makes it difficult to ascertain the context of the act. Therefore, it was unlikely that the camera would adequately capture an illegal act being performed by a third party due to the time delay. However, if an illegal act were clearly occurring in the images, the researchers would seek further legal advice.

The feasibility study received approval from the University of Otago Human Ethics Committee on September 4, 2012 (Ref No. 12/222).
Field test

A field test was conducted with six children aged 11-13 years. Each child wore the SenseCam for two consecutive days, following which the image data were downloaded and reviewed. A coding schedule was developed to record the time of exposure to marketing, the marketed product or brand, and the location and type of marketing seen in the images. This information, in combination with the time stamping on the images, suggested that this method could be used on a larger scale to objectively quantify children’s exposure to food and beverage marketing, and to estimate the total and setting specific duration of children’s daily exposure to food and beverage marketing. Finally, a focus group was held to discuss participants’ experiences of using the technology and participating in a research project of this nature.

The results of this feasibility study have been reported elsewhere (Barr et al., 2013; Barr et al., 2015). They indicated that the use of these methods might be effective in capturing children’s exposure to food and beverage marketing via multiple media and across multiple settings. The findings were used to support a programme grant application to the Health Research Council of New Zealand to conduct a large-scale research programme to identify effective and cost-efficient ways to improve population diets and health. The grant was successful, and the DIET programme was established. The Kids’Cam project is one of five research projects in the DIET programme, directed by Professor Cliona Ni Mhurchu at the National Institute for Health Innovation (NIHI), University of Auckland. The Kids’Cam study was led by Associate Professor Louise Signal at the University of Otago, Wellington.

Development of the Kids’Cam study

I had a role in conceiving the Kids’Cam study alongside Associate Professor Louise Signal (LS) (Kids’Cam Principal Investigator), Dr Moira Smith (MS), Dr James Stanley (JS), Professor Cliona Ni Mhurchu (CNM), and Professor Janet Hoek (JH).
Researchers and software developers from DCU, Dr Cathal Gurrin (CG), Professor Alan Smeaton (AS), Dr Zhengwei Qiu (ZQ), Dr Jiang Zhou (JZ), and Aaron Duane (AD), worked alongside CNM, LS, MS, JS and MB to develop the software interface for managing, storing, and reviewing and coding the images data. All aspects of the study design and data collection methods were collectively developed and agreed upon by LS, MS, JS, CNM, and myself. The following sections outline how the study population was identified and describes the sampling frame, sample size calculation and sampling methods used for the full Kids’Cam study. It also outlines the development of, and provides the rationale for, other aspects of the study design.

**Kids’Cam ethical approval**

Alongside LS and MS, I had a substantial role in developing the Kids’Cam application for ethical approval including the development of the information and consent forms for schools, parents, and children, as well as the discussion of potential problems in the study and the development of protocols to address these. I also developed the participant information cards and project instruction booklet for participants. Further, I developed the protocol for briefing children on the ethical and privacy issues associated with using wearable cameras. The ethical, legal, privacy and confidentiality issues associated with the use of automated wearable cameras have been discussed above and previously (Barr et al., 2013; Barr et al., 2015).

During the development of the Kids’Cam study, LS and MS held discussions with the University’s legal advisors and the Chair of the University’s Ethics Committee to ensure the ethical issues associated with the use of wearable cameras and conducting research with children were appropriately addressed. As the Kids’Cam study methods were developed and refined, additional amendments were sought and approved by the Ethics Committee.
Ethical approval was sought and initially granted by the University of Otago Human Ethics Committee (Health) (reference number 13/220) on 27 August 2013. In May 2014, the University of Otago Human Ethics Committee granted ethical approval to explore “the world children live in, their environment and how it impacts on them.”

**Māori consultation**

In accordance with the University of Otago policy on consultation with Māori, consultation with Ngāi Tahu was successfully conducted by LS and MS in August 2013. Further, Māori oversight was provided for the Kids’Cam project by Toi Tangata, through membership on the DIET Programme Advisory Group, which met at key stages throughout the study, and through the participation of Christina McKerchar on the Kids’Cam team (Ngāti Kahanunu, Tūhoe and Ngāti Porou descent).

**Sample population**

The focus of the Kids’Cam study was Māori, Pacific, and New Zealand European school children in Year 8 from across the Wellington region. Collectively, LS, MS, JS, CNM, and I decided to restrict the sample to New Zealand’s three major ethnic groups as childhood obesity, and its associated complications, are disproportionately prevalent among Māori and Pacific children compared to non-Māori, non-Pacific children (Ministry of Health, 2014). When Kids’Cam was designed (2014), the prevalence of overweight and obesity in New Zealand was lowest among the Asian populations (Ministry of Health, 2014). Further, this study had limited funding. Therefore, Asian children were excluded from the sample population. We also limited the sample population to those children in their final year of primary school (Year 8), which included children aged 11-13 years. Collectively, LS, MS and I selected this age group as we considered children of this age to be the youngest who could deal with the demands of participating.
Sampling frame

The sampling frame included schools from across the Wellington region including Porirua, Upper Hutt, Lower Hutt, and Wellington City. Although the Ministry of Education includes the Wairarapa in the Wellington region, schools in that region were not included in our sampling frame. Data collection required researchers to visit each school on at least four separate occasions to conduct the invitation session, the briefing session, to collect the equipment following data collection, and to conduct the review session. The Wairarapa region begins approximately 62 km north of Wellington city, but could require up to 180 km of travel to visit schools in the north of the region. As such, repeatedly travelling would likely prove costly in terms of time and study resources and would be difficult for researchers to attend to schools in this region if there were urgent issues with the equipment. Therefore schools in the Wairarapa region were excluded from this sample. To be eligible for inclusion, schools were required to have a Ministry of Education assigned decile ranking; this excluded one very small school in the Hutt Valley. Private, state-integrated schools and Kura (Māori language immersion schools) were eligible for inclusion. In total, 93 schools were included in the sampling frame.

Publicly-funded schools in NZ are ranked by decile for funding purposes. School decile rankings are a measure of the socioeconomic position of a school’s students relative to other schools nationwide (Ministry of Education, 2017). They indicate the relative deprivation of the student population as a whole but do not account for the socioeconomic mix of students within the school. Further, school decile ratings are a measure of the relative socioeconomic position of the student population and the mesh blocks in which they live, rather than the area the schools are in (Ministry of Education, 2017). Schools are assigned a decile ranking from 1 to 10. Each decile contains approximately 10% of schools. Decile 1 schools draw the highest proportion of their students from areas of the highest socioeconomic deprivation, while decile 10 schools draw the highest proportion
of their students from areas of low socioeconomic deprivation (Ministry of Education, 2017). For the Kids’Cam study, schools were grouped into low (deciles 1-3), medium (deciles 4-7), and high (deciles 8-10) decile tertiles for sampling and data analysis.

The sample size calculation and methods of sampling used in the full Kids’Cam study are discussed in Chapter Five.

**Length of data collection**

Collectively, the research team agreed that the length of data collection be four days to encapsulate two weekdays and two weekend days. Both week and weekend days were included to account for day-to-day variation in children’s daily activities and routines. Further, the data collection period was limited to four days as there was a significant participant burden associated with wearing and charging the equipment for Kids’Cam.

**Technology and data collection constraints**

Budgetary constraints limited the number of Autographers that were purchased for the study. Each Autographer unit cost $399 USD ($482 NZD in 2014). In total, 34 Autographers and 22 GPS devices were purchased. MS and MB initially trialled the Autographers and found the battery life to be approximately 8 to 9 hours when set to the highest image capture rate (one image every 7 seconds). Therefore, the battery life was insufficient to document all waking hours. As there was no way of extending the battery life beyond 8 to 9 hours, LS, MS, and MB collectively decided that each child would be given two cameras to wear throughout the day, one for the morning and one for the afternoon. Further, when the GPS function on the Autographer was activated, the battery life was reduced significantly. This limitation necessitated the use of a separate external GPS device. Based on the number of Autographers available, it was determined a
maximum of 16 children could collect data at any one time. Two cameras were kept as spares in case of equipment breakages or failures during data collection.

Given the number of cameras and the need to recruit participants from a range of schools across the region, data collection occurred over a 12 month period. Data collection also took place over a 12 month period to account for seasonal variation in advertising campaigns and children’s activities.

**Development of data collection documents**

**Information and consent forms**

I developed information sheets and consent forms for schools, parents, and participants with supervision from LS and MS (Appendix 1). In line with our ethical approval requirements, information sheets for participants and parents contained the information on the study aim, the study funders and ethical approval number, how they/their child were chosen to participate and that participation was voluntary, what the participants would be asked to do, how the collected information would be kept secure, and how the confidentiality and anonymity of study participants and any third parties appearing in the images would be protected. The information sheets also stated that after reviewing their images once, the participants would no longer have access to the images to ensure that they did not enter the public domain. The information sheets also contained LS’s and MS’s contact information. The participant information and consent forms were written using age-appropriate language. The consent forms emphasised the voluntary nature of the study and clearly outlined what was involved in participating.

**Demographic questionnaire**

Basic demographic information was also collected to describe the study sample. A demographic information sheet was attached to the parent consent form for the parent and child to complete. MB led the development of the demographic information sheet. The demographic information sheet consisted of six questions
about the child’s gender, ethnicity, date of birth, home address, phone number (if applicable), parents phone number, and the eight questions used to determine the New Zealand Index of Deprivation for individuals (NZiDep) score (discussed below) (Appendix 2). Children’s birthdates were collected to determine their exact age to enable the calculation of their age and gender-specific BMI. Information on children’s ethnicity was collected using the ethnicity question from the 2006 New Zealand Census of Population and Dwellings (Statistics New Zealand, 2006).

The demographic information sheet also asked participants to supply their primary residential address. This information could then be used to determine their New Zealand Deprivation Index 2013 (NZDep2013) score. The NZDep2013 is a non-occupational, area-based measure of socioeconomic deprivation, developed as a tool for use in resource allocation, advocacy and research (Atkinson et al., 2014; Salmond & Crampton, 2012b). NZDep2013 was developed using the results of deprivation characteristics collected during the New Zealand censuses (Salmond & Crampton, 2012b). The index was designed to provide information on the relative deprivation of those living in area mesh blocks of approximately 100 people (Atkinson et al., 2014). NZDep2013 scores range from 1 to 10, with 1 representing areas of lowest socioeconomic deprivation and 10 representing areas of highest socioeconomic deprivation.

The New Zealand Index of Deprivation for Individuals (NZiDep) is a non-occupational measure of individual socio-economic deprivation (Salmond et al., 2014). An individual’s NZiDep score is based on a series of eight questions that relate to the following eight deprivation characteristics, buying cheap food, employment status, receiving a means-tested benefit, feeling cold to save money on heating costs, receiving help to obtain food, wearing worn-out shoes, going without fresh fruit and vegetables, and receiving clothes or money from community organisations. NZiDep is a five-point index, with index scores ranging
Developing data collection protocols

The initial Kids’Cam data collection protocols were developed based on those methods used in the 2012 feasibility study and previous research conducted with wearable cameras. The methods of sampling and selecting schools and participants for the full Kids’Cam study were developed by the Kids’Cam biostatistician (JS), in discussion with the Kids’Cam team, and are discussed in Chapter Five. When developing the data collection protocols, LS, MS and I collectively agreed that there were six distinct stages in data collection, each requiring its own protocol. These stages included school recruitment, participant recruitment, the participant briefing session, equipment collection and image data download, the image review session, and the post-image review data download. Protocols for each stage were developed by LS, MS with substantial input from me and compiled into the Kids’Cam Protocol Handbook (Appendix 3). I led the development of the initial data collection protocols for the pilot study with supervision from LS and MS.

I also led the development of the study instruction manuals for using the Autographer and GPS device. The instructions for use were adapted from the manufacturer’s instructions and personal experience of using the devices. The instructions were translated into age-appropriate wording and compiled into an instruction manual for the participants (Appendix 4).

Pilot study

In 2014, there were no published protocols to inform the use of the Autographer in a research setting. The Kids’Cam study also required the additional collection of GPS data, and participants’ heights and weights. Further, the Kids’Cam study had a qualitative component to ascertain children’s views on food marketing and how it could be restricted. As such, a pilot study was conducted in April 2014 to field-test
the Autographer, GPS device, qualitative interview schedule, and study procedures.

I led the pilot study, with oversight from LS and support from MS and GJ. The pilot was an essential step in developing and finalising the study protocol as the research team was unfamiliar with the new technology. Therefore, initial study protocols were developed based on the previous collective experience of using wearable automated cameras and the limited information and experience we had in using the Autographer (pictured in Figure 5).

![Autographer and GPS device](image)

**Figure 5** Autographer (left) and GPS device

The purpose of the pilot study was to answer the following questions:

1. Can the Autographer and GPS device consistently collect data over the four-day period?
   
   a. What is the battery life of the camera and GPS device?

2. Do the developed study procedures, instruction manuals, and information sheets enable the collection of robust data?

   a. How can they be improved?
3. What are the participants’ experiences of using the Autographer, the GPS and participating in this research?

Pilot study overview

The pilot study was conducted in April 2014. A local intermediate school was purposively selected to participate, and a project information sheet was sent to a facilitating teacher and the principal. A meeting was held between the facilitating teacher, the school principal, LS, MS, and MB to discuss the details of the project and what the school would be required to do. Written consent from the principal to conduct the pilot study was obtained at this time. Following this meeting, a brief description of the study (developed by MS with input from MB) to inform the school community about the study was given to the principal for inclusion in the school newsletter. This gave the school community the opportunity to raise any concerns or object to the study being conducted. In line with our obligation to inform the school community under our requirements of ethical approval, the study would not have proceeded if the school community objected to the study or had unresolved issues with the study. However, the school principal did not receive any concerns from the school community.

Twelve children were randomly selected and invited to participate from one composite Year 7 and 8 class. A list of student names, their dates of birth and ethnicity were obtained from the facilitating teacher. Children’s names were then entered into a Microsoft Excel spreadsheet, separated by ethnic group, assigned a random number, and then ordered according to that number. The first four names in each of the Māori, Pacific, and New Zealand European lists were then sent to the facilitating teacher for their review against our exclusion criteria: children who were unable to collect data and deal with the demands of the study due to disability or circumstance. In this instance, no children were excluded and invitation packs were given to the teacher for distribution to each of the 12 randomly selected children.
MS and I prepared the invitation packs containing information and consent forms for parents, and separate information and consent forms for the invited children. The parental consent forms also included the demographic information questionnaire. Ten completed child and parent consent forms were returned (83% response rate) before the briefing session. Data collection was conducted over a four day period. All ten participating children completed the pilot study (100% completion rate).

Following data collection, focus groups were held with the participants to evaluate the data collection process. The school principal and facilitating teacher were also interviewed for feedback. On completion of the pilot study, the principal and facilitating teacher were informally interviewed by MS for their feedback on the experience of being involved in the study.

**Briefing Session & Data Collection**

Prior to data collection, three members of the research team (LS, MS, and I) ran a briefing session. At this session, signed participant and parental consent forms and the participant demographic information sheets were collected and checked to ensure that the relevant sections were completed by the child’s caregiver and the participant. A discussion of the project’s aims and instructions followed, as well as discussion of the ethical, legal and practical issues associated with using the Autographer and GPS devices. To give the participants a sense of the type of data the camera collects, they were shown a sample of image data. All ten consenting participants attended the briefing, which lasted approximately one hour.

At the briefing session, we walked the children through the information that I had compiled in the project instruction manual. We explained that we were interested in studying children’s environments and how these might impact on their health. As such, children were instructed to wear the Autographer and GPS device for four consecutive days, Thursday, Friday, Saturday, and Sunday. Participants were told that they could remove the devices at any time for any reason. They were also
encouraged to remove the camera in situations where others may be uncomfortable with its presence including: before entering changing rooms (school, club, and swimming pool); toilet or shower facilities; or in any other situation or location in which people could be partially clothed or would feel uncomfortable being photographed for example, in doctors’ offices, hospitals, and hospices. Additionally, participants were asked to either activate the privacy setting on the camera when using the bathroom, or to turn it off and remove the device. They were also advised to remove the camera when entering retail outlets where signage advised that photography was prohibited.

The participants were also briefed on how to handle any attention while wearing the camera. If approached, they were advised to explain that they were participating in a study conducted by researchers from the University of Otago, Wellington; that the project aimed to document their environment; and that they were wearing a camera that automatically takes pictures continually throughout the day. Furthermore, they were advised to say that they were not intentionally taking photographs of specific people or places. As an alternative, we provided the participants with information cards (developed by MB) to hand out if approached by interested parties while they were wearing the camera (shown in Figure 6). They were also encouraged to tell interested parties to contact the researcher using the contact details given on the information card if they required additional information or had further questions.
Figure 6 Kids’Cam study information card

At this session, each participant was given an equipment box (Figure 7) containing two Autographs (one labelled morning and one labelled afternoon), a GPS device, an armband for the GPS device, a plug board with two camera chargers and a GPS charger, an instruction booklet and five laminated project instruction cards. The equipment boxes were prepared by MS and me. Each box was labelled with the participant’s name and their unique participant number. Using the instructions in the project instruction booklet, the children were shown how to use the Autographs and GPS device and were encouraged to try them on. At this time, the project instructions were given and children were asked to wear the equipment, beginning on Thursday of that week, from the time they got up in the morning until the time they went to bed that evening, and to charge both cameras and the GPS overnight. Children were instructed to wear the morning camera from the time they got up until 3 pm or when they got home from school, at which time they were instructed to put on the afternoon camera to ensure that the whole day’s activities would be captured.

Although we did ask the children to wear the devices for as much of the day as was possible, we also reiterated that they could remove the device at any time, for
any reason. Information sheets detailing the children’s research tasks and written instructions for the devices were given out at this session. Additionally, contact details for the researchers and the date for collection of the devices were confirmed, and any other questions or concerns the children had were addressed. Children were notified of the date for the review session. Participants were then instructed to bring their equipment kit back to school on the Monday for collection by MB.

Figure 7 Example of Kids’Cam equipment box contents

The images from both cameras and the GPS data were then downloaded from each device and stored in participant specific folders on password-protected laptops. These were not viewed by the research team until after the review session outlined below.

The methods of data handling and storage for the full Kids’Cam study are discussed in Chapter Five.
Review Session

Participants attended a third session during which they had the opportunity to review their images in private and delete anything they did not want the research team to see. Images were reviewed using the Autographer desktop software which was supplied by the manufacturer. Children were shown how to delete images and were left to review their images in private. Finally, to pilot the semi-structured interview schedule for the qualitative portion of the Kids’Cam study, each child was interviewed individually for approximately 20 minutes about their thoughts on food marketing. As the qualitative arm of the study is beyond the scope of this thesis it will not be discussed further.

Anthropometric measures

Following the interview, participant’s heights and weights were measured and recorded. This data was entered into a spreadsheet alongside the basic demographic information collected by the demographic questionnaire. To measure children’s heights and weights, we employed the equipment and methods used in the New Zealand Health Survey.

A laser height measure was used to measure each child’s height. Adopted for use in the New Zealand Health Survey in July 2012, this instrument replaced the traditional stadiometer as it provides a more accurate measure of individual height (Ministry of Health, 2013). Children’s heights were measured according to the protocol outlined in New Zealand Health Survey Protocols for Collecting Objective Measurements (CBG Health Research Limited, 2014), including the removal of shoes, jackets, or other bulky outer clothing. The laser measuring device (shown in Figure 8) consists of a custom made aluminium headboard and a Precaster CA770 electronic laser measure (CBG Health Research Limited, 2014). The laser measure is held up to the corner of a wall and the participant asked to stand on a wooden board with their feet together, buttocks and shoulders touching the wall, looking forward with their head in the Frankfort Plane (Figure 9) (CBG Health Research Limited, 2014).
The laser height measure is then placed against the corner of the wall approximately 20cm above the participants’ head and turned on (CBG Health Research Limited, 2014). The measure is then lowered onto the participants’ head, and the measurement taken by pressing the measure button on the laser device (CBG Health Research Limited, 2014). The process was then repeated once more. If the first and second measurements differed by greater than or equal to 1%, a third measure was taken, and an average of the three measures was recorded. The laser height measure used was loaned to the Kids’Cam research team from the New Zealand Ministry of Health.

![Figure 8 Laser height measuring device](image)

![Figure 9 Head in the Frankfort plane](image)
The participants were weighed using HD-316 Wedderburn Scales (TANITA Corporation, Tokyo Japan) according to the Protocol for Collecting Height, Weight, and Waist Measurements in New Zealand Health Monitor (NZHM) Surveys (Ministry of Health, 2008b). The scales were placed either on a hard surface (if available) or the wooden board. After turning on the scales and zeroing them, the participant was asked to step onto the scales and the child’s weight was recorded to the nearest 0.1 kg. As with the height measurements, a second measurement was taken. If the difference in measurements was greater than or equal to 1%, a third measurement was taken, and the three measures were recorded and then averaged to produce the final measurement.

At the end of the review session, each child was presented with a certificate of participation and a $30.00 gift voucher for either Whitcoulls (bookstore) or Rebel Sport (sporting goods store) to thank them for their time and effort. The school was also presented with a certificate of participation, a letter of thanks and a $100.00 Whitcoulls voucher. The participants and schools were not aware that they would receive these vouchers until they were given at the completion of the study.

**Focus group**

Following the review session, two focus groups were held, each with five participants, to discuss and evaluate the pilot study. The two focus groups were conducted at the same time, MS conducted one focus group and I conducted the other. A semi-structured interview schedule (Appendix 5) was used to frame the discussion and it ran for approximately 20 minutes. I developed the questions for the focus groups with supervision from MS. Each group was asked a series of nine questions relating to their experience of wearing the Autographer. This included questions about handling any attention they received as a result of wearing the Autographer; length of time and number of days they were required to wear the devices; clarity of the project instructions and information resources; how the project could be improved; and the experience of participating in research.
Although the focus groups were recorded, they were not transcribed verbatim. However, each of the recordings was replayed, and I recorded participant responses under each question. I identified key themes in these notes and incorporated the feedback into the pilot study evaluation report.

**Pilot study evaluation**

Key results from the pilot study and subsequent changes to the Kids’Cam methods are discussed below.

**Issues during data collection**

Pilot study participants encountered few major problems during the four-day data collection period, which were largely due to the battery life of the camera, clarity of instructions about charging the devices, and how the GPS device was worn. During the briefing session, the children were instructed to put on their morning camera when they first got up in the morning and to put on the afternoon camera at 3 pm or after school. However, feedback during the focus group indicated that the battery life of the Autographer only lasted until lunchtime (between 12 and 1 pm). Consequently, the instructions for the full Kids’Cam study were changed and children were asked to take the afternoon camera to school with them, and to put on the afternoon camera at 1 pm or during the lunch break. Despite testing the battery life prior to the pilot study, it is likely that the battery life was shorter than expected during the pilot study as the Autographer has a light sensor and automatically captures an image when it senses significant changes in ambient light levels. When MS and MB tested the cameras, they were primarily using them in an office environment or outdoors. As such, there was little variation in the ambient lighting and therefore the camera would primarily capture images at the prescribed intervals only. For the pilot study participants, it is likely that the camera captured images more frequently (in response to changing light levels) and therefore the battery life was shorter than expected.
The pilot study participants also reported that the GPS armbands were uncomfortable and ill-fitting. As such, the armbands were replaced with lanyards for the full Kids’Cam study to enable the GPS devices to be worn around the neck under the top layer of clothing. Changes were made to the briefing notes and project instruction booklet to clarify instructions for charging the equipment.

**Issues identified about the review session**

Participants had the potential to collect a large amount of data during the four-day collection period. Therefore, the image review process was time-consuming, particularly when participants had a large number of images (up to 4000 per day), typically taking 25 to 30 minutes to review. Therefore, for the full Kids’Cam study we advised teachers that we would require approximately 30-40 minutes with each child for the review session, as an additional five minutes was needed to measure the child’s height and weight.

During the pilot review session, two of the children declined to have their weight measured. This was a concern as both children were visibly overweight, and there was a concern that this could be a common occurrence. The methods were amended to ensure that participants would be weighed in a private place, free from other children, and would be reminded that this information would be anonymised and only viewed by members of the research team. Additionally, children would have their height measured first to engage them in the process in a less threatening way.

**Teacher feedback**

When asked about their experiences of conducting the study during school time, the facilitating teacher reported being happy with the project overall and noted that it was less disruptive than he thought it would be. He attributed this to meeting with participants at a time when the rest of the class was doing individual work. He commented that it would have been more disruptive if we were meeting participants at a time when they were doing group work. The teacher reported that although the Autographers were initially a novelty for the whole class, it wore
off quickly and the class forgot that the cameras were there. The school principal had no concerns from the school community in relation to the project. He commented that the project appeared to go well and liked the idea of his students being involved in research.

**School and participant recruitment**

The process of how we would contact schools and invite them to participate was an issue raised collectively by LS, MS, and me following the completion of the pilot study. We had not encountered any difficulty recruiting a school for the pilot study as members of the research team had worked with the school on two previous occasions. However, a formal procedure was developed for approaching and recruiting schools by LS, MS and myself as we needed to recruit approximately 24 randomly selected schools. Each school was contacted by a senior member of the research team (LS or MS) by phone, and invited to participate. This phone call was followed by an email containing the information sheet for schools, and then an initial meeting with the principal or head teacher.

The school community was informed before participant recruitment to reduce the risk of a parent or child objecting to the study during data collection. At the pilot school, the principal decided that the best way to inform the school community about the study was to include a short description of the study in the school newsletter, which was sent home to parents before participant recruitment. Although this was the appropriate way of informing the school community in this instance, there was collective agreement among the research team that the best approach would be determined by working with each school individually.

Determining appropriate times to conduct the research during the school day was also to be decided by each school individually. Feedback from the facilitating teacher indicated that the least disruptive time to meet with the children would be during their individual work time. Feedback from the facilitating teacher and school principal also suggested that interval or lunchtime is not a good time to meet with children as they see it as a ‘punishment.’ As we met with participants on
three separate occasions during the pilot study, it was determined that we would need to be flexible with meeting times to fit in with the school’s curriculum.

**Participant recruitment and selection**

The pilot study highlighted issues regarding participant recruitment. A list of names of the randomly selected children was sent to the facilitating teacher, following random selection from the class list. The teacher was asked to advise the researchers of any students who would not be capable of completing data collection. However, this raised the issue of allowing the teacher too much input as to who would be invited to participate, which would compromise the random sampling strategy and potentially bias the sample. As a result, strict inclusion and exclusion criteria were developed by LS, MS and MB to reduce the risk of teachers excluding potential participants on the basis that they were perceived to be forgetful or irresponsible. The following criteria are below.

*Inclusion criteria*

Child’s expression of interest in participating in the study, provision of written consent, and commitment to the attendance of multiple sessions at school either during class time and lunchtimes or before or after school. The written parental consent to participate.

*Exclusion criteria*

No participant or parental consent or desire to participate. Children who are unable to collect data and deal with the demands of the study due to disability or circumstance were also excluded. Children who did not belong to the NZ European, Māori, or Pacific ethnic groups were also excluded.

**Changes to protocols and the development of a risk management strategy**

The pilot study and the accompanying evaluation provided valuable information on how the methods could be refined and adapted to streamline the data collection processes. Following the pilot study, I made amendments to the
instruction manuals and study protocols under the supervision of MS. Following the pilot study, I developed a risk management strategy for the full Kids’Cam study, informed by the pilot study and the feasibility study conducted in 2012. The risk management strategy contains details of the foreseeable risks to the full Kids’Cam study as well as strategies for their management. These strategies were incorporated into the data collection protocols for the full Kids’Cam study. The Kids’Cam risk management strategy is attached in Appendix 6.

**Chapter summary**

This chapter has discussed the development of the Kids’Cam study including the Kids’Cam research aims, the study sample, and the development of study documents and protocols. Details of the pilot study and its contribution to the refinement of study protocols and methods were also discussed. The following chapter contains details of the methods of sampling, recruitment, data collection and data management used in the full Kids’Cam study and this thesis. Chapter Five also contains details of the methods of image coding and statistical analysis used to answer the research questions specific to this thesis.
Chapter Five: Methods

Introduction

This chapter describes the methods of sampling, recruitment, data collection and analysis used in Kids’Cam. It is the first detailed outline of this innovative method for public health research. This chapter expands the description of the method published by the research team, of which I am one of the authors (Signal, Smith, et al., 2017).

In Kids’Cam, a point sampling method of observation was employed using wearable cameras that automatically captured an image of the wearer’s environment approximately every seven seconds. The resulting images were then analysed using content analysis and bespoke computer software. This chapter discusses the processes of developing the coding schedule for content analysis and the development of the annotation (coding) software used to code the images for Kids’Cam and my thesis. Details of the methods of statistical analysis used to determine children’s exposure to non-core and core outdoor advertising overall, and on the journey to or from school, are then given.

This thesis uses data collected in the Kids’Cam study and the Kids’Cam analysis framework to specifically address the research questions outlined in Chapter Four. I had a central role in developing the methods of recruitment, data collection and content analysis for the Kids’Cam study which I completed as part of this thesis. The methods presented in this chapter are those developed for Kids’Cam and therefore also used in my thesis. My role in the analysis of the Kids’Cam data was an in-depth look at children’s exposure to food advertising in outdoor settings.
Kids’Cam methods

Descriptive cross-sectional study design

A descriptive cross-sectional study design was used in this thesis to investigate the extent and nature of children’s exposure to outdoor food and beverage advertising and to investigate socioeconomic, ethnic and gender differences in this exposure, and differences by BMI. These issues have not been adequately described previously. Descriptive study designs are widely used in health science research to describe the prevalence of an attribute or disease and its associated trends and distribution at a population level (Webb & Bain, 2010). Cross-sectional study designs are used to obtain information about a population at a certain point in time (Grimes & Schulz, 2002). Information about the exposure of interest (outdoor advertising), and the outcome (BMI) are collected concurrently, making a cross-sectional design a time and cost effective study design (Grimes & Schulz, 2002). However, a key limitation of such studies is that they typically cannot identify the temporal relationship between exposure and outcome, and hence are limited in their ability to provide evidence of causation. The Kids’Cam study sought to describe children’s exposure to food marketing, as such it did not seek to establish causation but rather to investigate possible associations between food marketing exposure and obesity.

Sampling strategy

Sample size

JS performed the sample size calculation, in consultation with the Kids’Cam team. Initial sample size estimates suggested a sample size of 168 participants. When allowing for a 25% dropout and incomplete data, the total sample size was 224 children to recruit. This number was difficult to determine as there was little available data on expected exposure to advertising across settings. Therefore, the sample size was determined based on an estimation accuracy approach for
determining the mean number of advertisements seen per day across children. It was assumed that children saw a mean of 60 advertisements a day and a standard deviation of 20 advertisements (95% CI 20-100 advertisements per day).

As we were interested in identifying differences in exposure to food marketing between Māori, Pacific, and New Zealand European children, the principle of equal explanatory power was incorporated into the Kids’Cam study design. The principle of equal explanatory power recognises that health surveys that include Māori should produce data about Māori that can be analysed in “equal depth and breadth” to those of other population groups (Te Rōpū Rangahau Hauora a Eru Pōmare, 2002, p. 3). Random samples of the New Zealand population will include approximately 15% Māori (Te Rōpū Rangahau Hauora a Eru Pōmare, 2002). However, Māori bear a disproportionate burden of poor health outcomes in New Zealand. Therefore, without equal explanatory power, survey findings will predominantly reflect Pākehā (non-Māori) profiles of exposure or access to social determinants of health, health behaviours, use of health services, and outcomes. Policy and programmes developed on the basis of this type of data will therefore be more likely to meet Pākehā health needs than Māori health needs (Te Rōpū Rangahau Hauora a Eru Pōmare, 2002, p. 3).

To address this, equal numbers of Māori and non-Māori should be sampled to ensure that the same analyses can be performed on the data collected from all population groups (Te Rōpū Rangahau Hauora a Eru Pōmare, 2002). This allows researchers to explore explanations for any observed differences in health outcomes between Māori and non-Māori. Consequently, this information can be used to plan and develop interventions that are at least as effective for Māori and non-Māori (Te Rōpū Rangahau Hauora a Eru Pōmare, 2002). Using this approach in the Kids’Cam study design, equal numbers of Māori, Pacific, and New Zealand European children were recruited to enable the same statistical analyses to be
performed on data collected by children from each population group. Based on a total sample size of 168 children, 56 children were required from each of the three ethnic groups. Kids’Cam also aimed to identify differences by socioeconomic deprivation. Although a crude deprivation measure, school decile groupings were selected for use in Kids’Cam (and therefore also in this thesis) as a proxy measure of socioeconomic deprivation. As discussed in Chapter Four, school decile rankings are a measure of the socioeconomic position of a school’s students relative to other schools nationwide (Ministry of Education, 2017). Decile ten schools have the lowest proportion of students from areas of high deprivation and decile 1 schools have the highest proportion of students from areas of high deprivation. School decile was used as children were sampled and recruited through schools to maximise the number of participating children from a diverse range of socioeconomic positions. Therefore, in addition to equal numbers of children from each ethnic group, equal numbers of children were recruited from low (deciles 1-3), medium (deciles 4-7), and high (deciles 8-10), schools.

This gave a sample size of 28 children per study group. JS estimated this would include a margin of error of 7.5 advertisements (under the assumption that children were exposed to 60 advertisements per day) and would allow 80% power to detect differences in means between these groups of 15 advertisements per day. Further refinements of the study design required accounting for the clustering of observations within schools and sampling within school deciles organised into low, middle, and high strata. Based on the adjustment of the sample size calculations presented above, this sampling design would have 80% power to detect a difference in means of 25 advertisements per day between groups.

**Sampling methods**

**Schools**

School sampling was conducted by JS. A list of all schools in the Wellington region whose roll included Year 8 students was obtained from the Ministry of Education
This list included total numbers of Year 8 students per school and the number of students by ethnicity. The list of schools was then stratified into three groups based on their decile rating. Low decile schools were those with a decile ranking of 1-3; medium decile schools were those with decile rankings 4-7, and high decile schools had a ranking of 8-10. This first-stage sampling of schools was performed separately for each of the three ethnic and decile groups. Schools with very low numbers of Māori and Pacific children were excluded from the sampling frame. Exclusion of such schools improved the likelihood of there being sufficient numbers of children for the selected ethnicity at each of the selected schools. This gave a maximum of 12 schools (four for each ethnicity) in each decile group, and a maximum of 36 schools for the sample. Therefore, for each ethnicity/decile combination, a total of four schools were selected. As the sampling process was separate for each ethnic group, the same school could be selected for New Zealand European, Māori, and Pacific students in a particular decile group. As such, the total number of schools selected was 24 rather than 36. The above selection process was repeated to identify another school when the originally selected school declined an invitation to participate.

To give larger schools higher probabilities of being selected, within a given stratum, schools were selected on the basis of probability-proportional-to-size sampling methods. Sampling was performed in SAS 9.4, using the PROC SURVEYSELECT procedure, employing the probability-proportional-to-size method for school selection (with systematic selection within these strata).

It was difficult to find schools in each of the three school decile groupings with a sufficient number of children in each ethnic group to meet recruitment targets. Therefore, it was necessary to select schools separately for Māori, Pacific, and New Zealand European children. For example, there are very few Pacific children attending high decile (deciles 8-10) schools. Further, Māori and Pacific children are overrepresented in high deprivation areas and therefore typically attend lower decile schools. Restricting our sampling frame to include only schools with
sufficient numbers of all three ethnic groups would have meant a poor selection process for determining exposure levels to food marketing according to ethnicity, and also the combination of ethnicity and school decile.

In this thesis, the main comparisons of interest were those by ethnicity, school decile (as a proxy for area-level deprivation), BMI, and gender. As participants were recruited through schools, participant ethnicity was determined according to their listed ethnicity on the roll of Year 8 students obtained from the Ministry of Education. Information to determine NZDep and NZiDep scores were collected for the Kids’Cam study to allow for analyses based on more accurate measures of deprivation than school decile and to allow for comparison between groups by deprivation level. However, deprivation analyses in this thesis were conducted using school decile as a proxy for area-level deprivation. School decile groupings were selected as children were sampled and recruited through schools to try and maximise the number of participating children from each ethnic group and socioeconomic position.

**Recruitment**

**School recruitment**

Principals at the randomly selected schools were first approached by LS or MS by phone, to determine their enthusiasm for participating in the study and to arrange a meeting time. This was followed by an email containing further details of the study and the information sheet and consent forms for participating schools. LS or MS and a lead researcher (either TC or me) would then meet with the principal to discuss the project and obtain written consent from the school to conduct the study. LS or MS and a lead researcher also conducted staff briefings at participating schools, if required to do so by the school principal, to inform teachers about the study and what the participants were required to do. This was also an opportunity for the research team to answer questions or address concerns about the study. After consent was obtained from the school, the
principal was emailed a brief study description to include in the school newsletter to inform the school community about the study. Schools were asked to ensure that it was in the newsletter at least one week before the invitation session.

**Participant sampling and recruitment**

*Sampling*

Year 8 lists containing student names and their ethnicities were obtained from participating schools, which were then entered into an Excel spreadsheet, separated by ethnicity. A simple random sampling method was used to produce a random list of names using the R package for statistical computing (http://www.r-project.org/). This list of names was then emailed to the school principal or corresponding teacher. Teachers were asked to review the list alongside the study inclusion and exclusion criteria (outlined in Chapter Four) to identify children who should not be invited to participate. The reasons for these exclusions were not recorded. However, teachers were asked to exclude those who were unable to collect data and deal with the demands of the study due to disability or circumstance. After the list had been reviewed by the school principal, the final list of children to be invited to was confirmed, and a time to conduct an invitation session was arranged.

*Number of children invited and recruited from each school*

During the first cycle of data collection, we aimed to recruit six Māori and six New Zealand European children from one medium decile school. As we had an 80% response rate during the pilot study, we initially invited 20 children to participate to recruit the target of 12 children. However, the response rate was just 50%, and we were only able to recruit ten children. Consequently, LS, MS, JS and me collectively agreed to over-invite children to participate on the basis that the response rate may be as low as 33%. Therefore, for the remainder of data collection, for every six children we required from a school, 20 were invited to participate. If 12 participants were required, a list of 40 names was randomly selected.
In total, 168 children were recruited from 16 schools across the Wellington region. Figure 10 (developed by MS) displays the number of schools invited to participate and the number that consented, broken down by school decile stratum. Figure 10 also displays the number of invited, consenting and participating children by ethnic group and school decile stratum.

Figure 10 Sampling and recruitment flow diagrams for schools and children, by ethnicity and school decile stratum.
Source: Signal, Stanley et al. 2017
**Data collection**

In total, I was involved in 14 of the 25 data collection cycles. I led data collection in eight schools over nine data collection cycles and assisted in a further five collection cycles. The timeline for a typical data collection cycle from the invitation session until completion of the review session is displayed below in Table 2. Details on the conduct of these sessions are detailed in the Kids’Cam Protocol Handbook (Appendix 3).

**Table 2 Sample data collection timetable**

<table>
<thead>
<tr>
<th>Week</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Saturday</th>
<th>Sunday</th>
</tr>
</thead>
<tbody>
<tr>
<td>Week1</td>
<td>Invitation session</td>
<td></td>
<td></td>
<td></td>
<td>Contact schools to check number returned forms</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 2</td>
<td>Finalise number of participants</td>
<td>Briefing session</td>
<td>Data collection</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 3</td>
<td>Equipment collection and data download</td>
<td>Review session</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Invitation session**

As shown in Table 2, the invitation session held with the randomly selected children was typically held on the Tuesday of the week before the proposed data collection start date. At this session, the researchers introduced themselves and discussed key details of the project. Children were advised that we were interested in learning about the world they live in and how it impacts their health. They were also advised that we wanted to find out more about the things they see and the places they go during the day. The children were shown the Autographer and GPS device. They were also told that if they were to participate, they would be asked to wear the equipment for four days, from Thursday to Sunday. Any
questions they had were answered, and information packs containing parent and participant information and consent forms and a demographic information sheet were distributed. After meeting with the children, dates and times to conduct the briefing session and review session were confirmed with school staff. On Friday of the same week, researchers emailed the school to check the number of consenting participants. To ensure an adequate number of equipment boxes were available and a sufficient number of children had consented to participate. The final number of consenting participants was confirmed on the day before the briefing session was held.

Preparation for the briefing session involved preparing the equipment boxes – charging all the cameras and GPS devices, and checking that each equipment box contained five laminated project information cards and an instruction manual. Each camera was checked to ensure that it was set to high capture mode and each GPS device checked for functionality. The plug board, and each of the camera chargers and the GPS charger were also checked to ensure that they were in good working order. Each equipment box was then labelled with a unique participant identification number. I prepared all of the equipment boxes for the cycles of data collection that I led and those that I assisted with.

Briefing Sessions

For each of the data collection cycles that I led, I conducted the briefing session. The briefing session was typically conducted on a Wednesday, the day before data collection began, or earlier in the week if school activities necessitated. As discussed in Chapter Four, the briefing session was conducted to talk through the study aims and instructions, to distribute the equipment boxes and to show the participants how to use the equipment. The briefing session also included a discussion of some of the ethical issues associated with using wearable cameras. The briefing session protocol can be found in the Kids’Cam Protocol Handbook (Appendix 3).
Before conducting the briefing session, the consent forms and demographic information sheets were collected from each of the consenting children and checked for completeness.

At the briefing session, children were instructed to wear the camera and GPS device during all waking hours and all of their normal daily activities from Thursday morning until Sunday night. The participants were asked to go about their usual activities as if they were not wearing the equipment. Children were instructed to remove the camera in all of the situations listed on page 9 of the Kids’Cam Protocol Handbook and received an instruction book that also contained a list of these situations. Briefly, these included when entering the bathroom or public changing rooms and anytime they were around someone who was partially clothed, before playing sport, anywhere there was a sign indicating that photography was prohibited on the premises, and in healthcare facilities. Participants were also told that they could remove the camera anytime they did not feel comfortable wearing it, for any reason. They were reminded that they would be the first person to view their images and that at the next session they would have the opportunity to delete any sensitive images (e.g. those captured in the bathroom), in private.

The participants were also briefed on how to handle any attention they may receive from other students or members of the public as a result of wearing the camera. As discussed in Chapter Four, they were given a statement they could recite and information cards they could give to the interested party.

The equipment boxes were handed out, and step-by-step instructions on how to use and charge the cameras and GPS devices were given. Participants were encouraged to try turning the camera and GPS devices on and off and checking that the camera device was on the correct setting. Following this, children had the opportunity to ask any remaining questions and were also reminded that they could withdraw from the study at any time, and would experience no penalty or disadvantage. Finally, children were asked to return the equipment to school on
Monday morning for collection by the researcher. At this time, the participants were also informed of the date and time of the review session.

After returning to the Kids’Cam office, the lead researcher then entered each participant’s demographic information (excluding their name) into an Excel spreadsheet (the demographic information spreadsheet) alongside their corresponding unique ID number. Signed consent forms and demographic information sheets were then stored securely in locked filing cabinets (full data security and handling protocols are discussed below).

**Equipment collection and data download**

The equipment boxes were collected from schools on the Monday following data collection. Alternative collection arrangements were made for any participants who had forgotten to return their equipment boxes or were absent on that day. Once returned to the Kids’Cam office, the data from each of the cameras and GPS devices were downloaded onto two password-protected laptops in preparation for the review session. The image data was directly downloaded from the Autographers into the Kids’Cam software browser, developed by the research team at Dublin City University (DCU), entered into participant specific folders. The GPS data was downloaded into the QSports software (proprietary software provided by the manufacturer) and uploaded into the appropriate participant specific folder in the Kids’Cam browser software. A copy of each participant’s Autographer and GPS data was then saved into participant specific folders on a password-protected external hard drive. To make more efficient use of our time spent at the schools, half of the children’s data was downloaded onto one laptop and the rest onto the other so that two children could review their images at the same time.

The Kids’Cam browser software was developed by Professor Alan Smeaton (AS), Dr Cathal Gurrin (CG), Dr Zhengwei Qiu (ZQ), Dr Jiang Zhou (JZ), and Aaron Duane (AD), at the Insight Centre for Data Analytics at DCU. So the children could easily review their images and the researcher could upload the images to the Kids’Cam
server, the research team at DCU developed a software browser to use on our laptops.

**Review Sessions**

The review sessions were held in the week following data collection at a time convenient to the school. During the review session, children were given the opportunity to review their images in private. Children were shown how to use the Kids’Cam browser software to review their images and how to delete any images that they did not want the research team to see. The participants were instructed to delete images they did not wish the research team to see, including those containing sensitive material, for example, images that they had captured in the bathroom or images containing partially clothed family members. Participants took approximately 25 minutes to review their images as the images could be easily scrolled through on the Kids’Cam browser software, enabling the images to be reviewed like a video. Following this, participants had their heights and weights measured in a private space in accordance with the methods outlined in Chapter Four. If a participant was unable to attend the review session on the arranged day, another time was rescheduled with the school.

At the review session, a random sample of children was interviewed for the qualitative component of the Kids’Cam study. In total, 33 interviews were conducted with participants from a range of schools, of which I conducted four. Interviews typically lasted 30 minutes. The interview schedule and protocol for conducting these interviews can be found in the Kids’Cam Protocol Handbook (Appendix 3). However, a discussion of this component of the study is outside of the scope of this thesis.

At the end of the review session, participants were presented with a Certificate of Participation and their choice of either a $30.00 voucher for Whitcoulls or Rebel Sport to thank them for their time and contribution to the study. At this time, schools were also presented with a letter of thanks, a certificate of participation, and a $100.00 Whitcoulls voucher to thank them for their participation.
Data management

A large amount of image data was generated during this study requiring specific facilities for management and storage. As discussed in the Kids’Cam risk management strategy (Appendix 6), arrangements were made with the University of Otago Data Centre to provide high-level security data storage, back-up and recovery via Syncplicity (the University’s secure cloud storage system). Upon completion of each data cycle, the original raw data from the cameras, the raw post-review image data, and GPS data from each participant were backed up to password-protected external hard drives. The external hard drives were held at the University of Otago, Wellington, and stored in a locked filing cabinet when not in use. Access to the data was restricted to named members of the research team, each of whom signed data release forms. Data were stored in compliance with all University policies on privacy and information security, the National Health Information Security Framework (Health Information Standards Organisation, 2015) and the Health Information Privacy Code (Privacy Commissioner, 1994). Members of the research team from the University of Otago, Wellington were responsible for data storage. All image data remain the property of University of Otago, Wellington.

After the post-review data had been backed up to the external hard drive, the image data were automatically uploaded to the main server using the Kids’Cam browser software. The image data were stored on the server and accessed using purpose-built annotation software (discussed in the next section). Access to the images via the software was password-protected.

To anonymise the demographic and anthropometric data, each participant was assigned a number. A master list containing all participant names and numbers was stored securely, in a locked filing cabinet separate from the anthropometric and demographic data. The participant list was only accessible to those team members who were directly in contact with the participants (LS, MS, TC, TL, and me).
Upon completion of the study, the data were transferred for long-term storage at the University of Otago Data Centre. The data will be stored for five years as per the policy of the University of Otago after which the data will be destroyed. The personal information (e.g. the participant names) collected from the sample will be destroyed at the conclusion of the Kids’Cam study.

**Image coding**

The following section describes the development of the image coding schedule, the development of the Kids’Cam annotation software, the development of the annotation protocols, and my role in their development.

**Content analysis**

Content analysis was selected for use in this study as the production of quantitative data from an image allows for comparisons between categories of interest within the images using traditional statistical methods. Content analysis involves identifying components of interest within a sample of text (visual or written) and counting the frequency with which they appear in the sample (Rose, 2007). It is frequently used to analyse images and other visual media such as television programming and film (Bell, 2001). As such, this form of analysis has been used widely to quantify the nature and extent of food marketing to children on broadcast, print and digital media (Jones & Reid, 2010; Kelly & Chapman, 2007; Kelly, King, et al., 2015; Settle et al., 2014). A key strength of content analysis is its flexibility as it can be applied to numerous forms of text, both visual (including images) and written, and to large datasets (Bryman, 2012).

However, when performing content analysis there may be some subjectivity in the application of the coding schedule as the coders will draw on their own experience and knowledge of the variable of interest when coding (Bryman, 2012). This was a concern in the present study as all coders had in-depth knowledge of some of the study locations and the marketing present in those locations. This was unavoidable as the coders lived in the same geographical area.
as some of the study participants. To ensure objectivity during image coding, a set of image coding rules and a protocol document to guide their use and application were developed by MS, TC, LS, and me. The development and application of these rules are discussed later in this chapter.

Rose (2007) identified four distinct stages in performing content analysis: collecting or sampling the texts (images), developing coding categories, coding the images and analysing the results. The processes of developing the coding schedule, the application of content analysis for the Kids'Cam, and therefore my thesis, are described below.

**Developing the image coding schedule and annotation software**

I led the development of the coding schedule for the Kids'Cam project. I also ensured that the coding schedule could be used to quantify the extent and nature of outdoor food advertising, in addition to addressing the primary Kids'Cam research question. The coding schedule and the computer annotation software were developed simultaneously.

The development of the coding schedule was an iterative and collaborative process involving LS, MS, TC, CNM, and me. I developed the initial structural framework drawing on previous research into food marketing to children and through an initial viewing of, and interaction with, the image data. A preliminary coding schedule was developed by identifying possible codes from the Kids’Cam research question: What is the extent and nature of children's exposure to food and beverage marketing?

To determine the nature of the food marketing, the coding schedule needed to be robust enough to collect information on the setting in which the exposure occurred, the marketing medium used, and the nutritional value of the marketed brand or product. The replicability, objectivity, and rigour of content analysis rely
on the development of a rigorously explicit coding schedule (Bryman, 2012; Rose, 2007). Therefore, the codes needed to be explicitly defined. Further, categories within the coding schedule had to be comprehensive and exclusive, that is, they had to include everything of interest within the image, but without any overlap between coding categories (Bell, 2001; Bryman, 2012; Rose, 2007).

However, there was a limit to how much detail could be included in the annotation software, as usability and speed of annotation were reduced with increasing levels of detail in the coding schedule. For example, including a large number of codes within the coding schedule (and therefore the annotation software) increased the time taken for each page in the annotation software to load, significantly increasing the time taken to navigate through the software and code the images.

This was a problem as the image data set was very large (1.3 million images) and had to be manually coded. There was also a limit to the number of codes that would be visible on the computer monitor at any one time. Ultimately, a three-tiered coding framework was developed whereby each relevant image was coded with a setting, marketing medium and food product category. The codes and coding framework are outlined in Table 3.

For ease of statistical analysis, JS, LS, MS, TC, and I determined that every image in the dataset be coded with one code from each of the three coding tiers (setting, marketing medium, and product category) irrespective of whether it contained food marketing. The data produced for statistical analysis were count-based numerator data. As such, Poisson regression models were used to determine the mean rates of core and non-core food marketing exposures for children from each demographic group. To provide a time-based denominator for the Poisson regression models, each image was specified as contributing seven seconds (the median interval between image capture) of exposure time. Therefore, other codes in the setting list in Table 3, such as ‘no setting’ and ‘uncertain’ were included to ensure that the three-tiered coding framework could be applied to every image, as
each image in the dataset was assigned at least one code. The protocols for image coding (annotation) are discussed later in this chapter.

**Table 3 Three-tiered coding framework**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Marketing Medium</th>
<th>Product Category</th>
</tr>
</thead>
<tbody>
<tr>
<td>School</td>
<td>Default</td>
<td>Default_1</td>
</tr>
<tr>
<td>Street</td>
<td>In-store marketing</td>
<td>Bakery 1,2+</td>
</tr>
<tr>
<td>Home</td>
<td>Print media</td>
<td>Cereal (unhealthy) 1,2,3+</td>
</tr>
<tr>
<td>Bakery – indoor</td>
<td>Product packaging</td>
<td>Confectionary 1,2,3+</td>
</tr>
<tr>
<td>Community venue</td>
<td>Merchandise</td>
<td>Cookies cakes and pastries 1,2,3+</td>
</tr>
<tr>
<td>Convenience store – indoor</td>
<td>Mobile food vendor</td>
<td>Convenience store 1,2+</td>
</tr>
<tr>
<td>Fast food – indoor</td>
<td>Screen</td>
<td>Core1,2,3+</td>
</tr>
<tr>
<td>Full-service restaurant</td>
<td>Sign</td>
<td>Diet drinks 1,2,3+</td>
</tr>
<tr>
<td>Fresh food market</td>
<td>Vending machine – external</td>
<td>Fast food 1,2,3+</td>
</tr>
<tr>
<td>Other retail</td>
<td>Camera not worn</td>
<td>Ice cream 1,2,3+</td>
</tr>
<tr>
<td>Outdoor recreation space</td>
<td>Uncodable</td>
<td>Milk product (unhealthy) 1,2+</td>
</tr>
<tr>
<td>Private transport</td>
<td></td>
<td>Other</td>
</tr>
<tr>
<td>Public transport – vehicle</td>
<td></td>
<td>Processed meats</td>
</tr>
<tr>
<td>Public transport – facility</td>
<td></td>
<td>Snack foods 1,2,3+</td>
</tr>
<tr>
<td>Service station – on-site</td>
<td></td>
<td>Sugary drinks and juices 1,2,3+</td>
</tr>
<tr>
<td>Shop front</td>
<td></td>
<td>Supermarket 1,2+</td>
</tr>
<tr>
<td>Shopping mall</td>
<td></td>
<td>Blurry/blocked</td>
</tr>
<tr>
<td>Sport</td>
<td></td>
<td>Camera not worn_1</td>
</tr>
<tr>
<td>Supermarket – indoor</td>
<td></td>
<td>Check</td>
</tr>
<tr>
<td>Vending machine – inside</td>
<td></td>
<td>Uncertain_1</td>
</tr>
<tr>
<td>No setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uncertain</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Settings
I identified each of the settings in Table 3, in consultation with the Kids’Cam team by reviewing several children’s images and recording all of the locations that they visited over the course of one day. Additional settings were added to ensure all foreseeable settings in which children spend time were included. As the promotional environment differs between each store type, food retail outlets were broken down into the following settings: supermarket, convenience store, fast food, full-service restaurant, and bakery. A setting called ‘Service station on-site’ was also included in the list of settings, which applied to the service station forecourt area only, while the service station retail stores were classified as convenience stores. The definitions for each setting are outlined later in this chapter and are displayed in Table 4.

Some of the settings listed in Table 3 were included primarily to enable a more detailed analysis of food advertising exposures in outdoor settings for my thesis. I identified the key outdoor settings in which advertising was found during an initial review of the image data, which included street, shop front, fresh food market, sport and outdoor recreation space.

Marketing Mediums
I also identified the list of marketing mediums shown in Table 3, again in consultation with the team, by reviewing the image data set and those listed in the WHO’s Framework for Implementing the Set of Recommendations on the Marketing of Foods and Non-alcoholic Beverages to Children (WHO Framework) (2012). At the time, I identified the WHO Framework as providing the most relevant and appropriate list of marketing mediums along with clear and comprehensive definitions of these marketing mediums. These definitions informed the development of the coding definitions outlined in Table 5. In this thesis, the ‘sign’ marketing medium was of primary interest. As defined in Table 4, the ‘sign’ marketing medium includes a range of marketing mediums that are commonly used in outdoor advertising.
Product categories

The list of food product categories in Table 3 was compiled from two reference documents, the WHO Regional Office for Europe Nutrient Profiling Model (WHO NPM) and Kelly et al. (2007). The development of this list and the rationale for the selection of these nutrient profiling models are discussed in detail later in this chapter.

Many of the product categories listed in Table 3 are accompanied by a number, 1, 2, or 3+. These numbers were used to record the number of different instances of marketing for foods in the same product category within an image. If an image contained 2 different instances of food marketing via the same medium, in the same setting, for example, a shop front with one sign advertising a juice product and one sign advertising a carbonated sweet beverage, the coder would code the image using the following codes, Shop front, Sign, Sugary drinks and juices 2. However, if the image contained 4 such instances of food marketing for the same product category via the same marketing medium, in the same setting, the image would be coded with Sugary drinks and juices 3+. The inclusion of numbers was limited to three levels within the coding framework to preserve the usability of the annotation (coding) software for the coders.

Refining and testing the annotation software

After developing the coding schedule, numerous meetings were held between myself, MS, TC, LS, TC, and ZQ, ZH, AS at DCU to refine the software platform to optimise user experience and streamline the software to facilitate time-efficient coding.

I had a central role in providing feedback on the annotation software and identifying possible improvements.

Within the software, each participant’s data were stored in a folder, identifiable by their unique participant ID number. The folder contained all four days of the participants’ image data. Figure 11 displays the view of the software the coder
saw when they entered each participant’s folder. The calendar shown in Figure 11 displays the dates on which the data was collected. In this example, March 5, 2015, is highlighted and the blue folders contain all of the images collected on March 5. Each folder contains one hour’s worth of images. Initially, the images were not contained in hourly folders. We requested that these be added to allow the images to be coded one hour at a time. As manual image coding required high levels of concentration, breaking the images up into groups of one hour allowed coders to have a short break upon finishing each hour and provided an obvious stop-start point to ensure that all images were coded.

Figure 11 Annotation software view 1

Figure 12 displays the view the coder saw when they are adding the codes to the images. Circled on the left of Figure 12 is the ontology. The ontology contains the Kids’Cam image coding schedule. Within the coding software, the three levels of the coding schedule are described in terms of a tree (setting), branch (marketing medium) and leaf (product category) structure. As shown in Figure 12, the image being coded is highlighted by a blue box around the image. This feature was added to ensure that the coder knew which image was being coded. After trialling the
software, we also requested that coders be able to code multiple images, with the same codes, simultaneously. As the images were taken at 7 seconds intervals, there were some sequences of images where the image changed negligibly from one frame to the next, particularly if a child was reading or sitting at their desk during school days. As such, we requested that a ‘select all’ option (circled in Figure 12) be added to the coding framework to enable quick coding of these long image sequences.

In Figure 12, the image has been coded with the following codes, Street (tree), Default (branch), Default (leaf). This image does not contain any food marketing and is therefore coded with a setting and two default codes to ensure that it is annotated with a code from all three levels of the coding schedule. Coding rules are discussed later in this chapter. After the first round of user testing, we also requested that an indicator be placed on each image once it had been coded to signal to the coder that it had been coded. The result was the placement of a numeral in the top left corner of each coded image reflecting the number of three-levelled codes for that image (circled in Figure 12). The codes attached to that image could then be viewed by clicking on the image.

Figure 12 Annotation software view 2
Defining the codes

Coding definitions were informed by a number of sources. Again, where possible, definitions for the settings and marketing mediums were taken from the WHO Framework for implementing the set of recommendations on the marketing of foods and non-alcoholic beverages to children (World Health Organization, 2012a). Although I developed the coding schedule for Kids'Cam, I was also interested in ensuring the outdoor settings were well defined and appropriately captured all outdoor settings in which children may be exposed to outdoor food advertising. Definitions of marketing mediums from city councils were also used as the placement of outdoor advertising in New Zealand is regulated at the local government level.

Definitions of food-related settings such as supermarkets, conveniences stores and restaurants were taken from previous research into food marketing to children and previous research investigating the retail food environment. Definitions for each of the food product categories were taken from the WHO NPM and previous research (Kelly et al., 2007). The product categories outlined in Kelly et al. (2007) have been used in a number of Australian and international studies to classify the nature of food marketing to children (Kelly & Chapman, 2007; Kelly, Cretikos, et al., 2008; Kelly, Halford, et al., 2010; Kelly, King, et al., 2015; Kelly et al., 2007).

The complete list of setting and marketing medium codes and their accompanying definitions are displayed in Table 4 and Table 5. I led the initial development of this list. However, the list of codes and their accompanying definitions were refined and/or expanded following initial testing of the coding schedule. The final codes listed in Table 4 and Table 5 were the result of a lengthy and iterative process of refining the coding schedule through long discussions between myself, LS, MS, and TC with oversight provided by CNM.

Bryman (2012) argues that all coders must have clear instructions on how each category is to be coded and that coders should have little discretion as to how
each text is coded. Such recommendations ensure the codes are consistently applied to each data set, and replicability and inter-coder reliability are improved (Rose, 2007). Therefore, to reduce ambiguity regarding how each image was coded, clear definitions of each of the codes were given in the coding schedule document as well as instructions on what to look for in the images.

**Setting**
The settings were the places or type of surroundings where the food marketing was captured.

**Table 4 Settings and accompanying definitions**

<table>
<thead>
<tr>
<th>Setting</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>School</strong></td>
<td>Indicated by the presence of classroom features such as desks, tables and chairs, other children, teaching staff, school buildings and playgrounds. School grounds are delineated by a gate and/or fence. The school is an institution for educating children and includes the building used by the school (Oxford Dictionaries, 2015).</td>
</tr>
<tr>
<td><strong>Street</strong></td>
<td>Roads, footpath and courtyards. The roads or public areas of a city or town (Oxford Dictionaries, 2015).</td>
</tr>
<tr>
<td><strong>Home</strong></td>
<td>Includes all spaces within the home gates and boundaries, i.e. indoor and outdoor spaces; or someone else’s home. The place where one lives permanently, especially as a member of a family or household (Oxford Dictionaries, 2015).</td>
</tr>
<tr>
<td><strong>Bakery - indoor</strong></td>
<td>Independent store selling fresh baked goods, e.g. Jack’s bakery, Baker’s Delight. A place where bread and cakes are made or sold (Oxford Dictionaries, 2015).</td>
</tr>
<tr>
<td><strong>Community venue</strong></td>
<td>Library - A building or room containing collections of books, periodicals, and sometimes films and recorded music for use or borrowing by the public or the members of an institution (Oxford Dictionaries, 2015). Recreation centre/community hall - a public space where meetings are held. Marae - includes the meeting house, dining hall, education and associated facilities and residential accommodation associated with the Marae. Church - A building used for public Christian worship (Oxford Dictionaries, 2015).</td>
</tr>
<tr>
<td>Convenience store - indoor</td>
<td>A smaller style food retail store with two or fewer checkouts (Thornton &amp; Kavanagh, 2012). E.g. dairy, Fix, Seven Eleven, neighbourhood corner store; Four Square; Does not include tuck shop. When the number of checkouts is not visible, then look for identifiable features such as independent store names (e.g. David’s food market) or the words Dairy, Convenience Store, Fix etc.</td>
</tr>
<tr>
<td>Fast food - indoor</td>
<td>Includes all major fast food franchised chain restaurants e.g. McDonald’s; KFC; Burger King; Pizza Hut; Dominos; Subway; Hell Pizza; Dominos. Easily prepared processed food served in snack bars and restaurants as a quick meal or to be taken away – Oxford dictionaries. Smaller takeaway food outlets such as roast chicken, Asian/Indian takeaways, pizza, and fish and chip stores or cafes where food is purchased for home consumption (Thornton &amp; Kavanagh, 2012).</td>
</tr>
<tr>
<td>Full-service restaurant</td>
<td>Restaurant or café setting with table service, wait staff (Powell &amp; Nguyen, 2013).</td>
</tr>
<tr>
<td>Fresh food market</td>
<td>Characterised by being outdoor, primarily selling fresh fruit, vegetables, fish and other perishables food products. These may be large or small local markets. May only be open a few days a week (Thornton &amp; Kavanagh, 2012).</td>
</tr>
<tr>
<td>Other retail</td>
<td>General product retailers including K-Mart, The Warehouse, Mitre 10, Bunnings; also Whitcoulls, and game and video stores. Primary purpose is something other than food retail or the sale of petrol.</td>
</tr>
<tr>
<td>Outdoor recreation space</td>
<td>Parks - A large public garden or area of land used for recreation (Oxford Dictionaries, 2015). Characterised by the presence of large open grassed spaces possibly with some equipment such as climbing frames or playgrounds (not primarily used for organised sport). Walking track - A rough path or road, typically one beaten by use rather than constructed (Oxford Dictionaries, 2015). Characterised by in bush or off-road areas such as the town belt. Beach - A pebbly or sandy shore, especially by the sea between high- and low-water marks (Oxford Dictionaries, 2015). River - A large natural stream of water flowing in a channel to the sea, a lake, or another river (Oxford Dictionaries, 2015).</td>
</tr>
<tr>
<td>Private transport</td>
<td>Inside a car, van or truck.</td>
</tr>
<tr>
<td>Public transport – facility</td>
<td>Associated with public transport facilities – e.g. bus shelters, train stations, airports etc.</td>
</tr>
<tr>
<td>Public transport – vehicle</td>
<td>Inside a bus, train, airplane, ferry.</td>
</tr>
</tbody>
</table>
Service station – on-site
An establishment beside a road selling petrol and oil and sometimes having the facilities to carry out maintenance (Oxford Dictionaries, 2015).
An establishment selling petrol and food including Z, Caltex, BP, Mobil. This definition includes the petrol pumps and forecourt area but not the street-side advertisements (coded as street).

Shop front
Where signs with branded information, pictures or logos displayed within a shop window or attached to the shop front. This includes posters, stickers, signs, neon signs and electronic boards. This does not include movable signs such as sandwich boards (Kelly, King, et al., 2015). Includes large signs above the door/veranda of the shop.

Shopping mall
A large enclosed indoor shopping area from which traffic is excluded (Oxford Dictionaries, 2015).
Includes food courts.

Sport
Swimming pool - council facility/publically accessible swimming pool.
Indoor sports stadium - sports stadiums that are used for recreational sporting games, e.g. ASB stadium.
Outdoor sports stadium - large regional stadiums where professional matches are held e.g. Westpac Stadium.
Sports clubrooms - club emblems and colours are on display.
Sports ground - outdoor area designed primarily for the purpose of playing sport (buildings and other associated structures).

Supermarket - indoor
Inside a supermarket with three or more checkouts. Sells fresh fruit and vegetables. Has long opening hours (Thornton & Kavanagh, 2012). E.g. Countdown, Pac’n’Save, New World, Moore Wilsons, The MAD Butcher.

Vending machine - inside
Food and beverage marketing seen on the inside of an electronic machine used to dispense a product after money has been put in the machine. These typically include the product packaging of the items being stored within the machine.

Marketing Medium
The marketing mediums were the channels used to impart the promotional messages.

Table 5 Marketing media and accompanying definitions

<table>
<thead>
<tr>
<th>Medium</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>In-store marketing</td>
<td>On-shelf displays. Includes displays at check-outs, pay-points, and end-of-aisles in supermarkets. Special offers and pricing incentives (World Health Organization, 2012a), e.g. Branded drinks fridges and branded stands, end-of-aisle displays, price signs, point-of-sale, promotional activity in-store. It is also the code to be used when coding for convenience stores and supermarkets.</td>
</tr>
<tr>
<td><strong>Print media</strong></td>
<td>Advertising and editorial content, gifts and promotions offered by the print media (World Health Organization, 2012). Includes newspapers, flyers, magazines.</td>
</tr>
<tr>
<td><strong>Product packaging</strong></td>
<td>Product labelling and packaging designs (World Health Organization, 2012a). Includes all food and beverage packaging seen in any setting. Includes bags, wrappers, and boxes with food and beverage logos.</td>
</tr>
<tr>
<td><strong>Merchandise</strong></td>
<td>Branded products used to promote a food or beverage product, e.g. vouchers, t-shirts, caps, bowls, glasses, drinks bottles. Definition adapted from Oxford dictionaries.</td>
</tr>
<tr>
<td><strong>Mobile food vendor</strong></td>
<td>Mobile food shop means a food stall contained on a motor vehicle or that is designed to be moved by a motor vehicle (e.g. a food stall in a caravan or on a trailer) (Auckland City Council, 2013). Includes food truck selling food such as ice cream, fast food, typically at a market, sports or cultural event.</td>
</tr>
<tr>
<td><strong>Screen</strong></td>
<td>Includes television, games console, mobile handheld device including smartphones and iPods, computer screen desktop or laptop, tablet, kindle. Advertisements for food and beverage products during commercial breaks, programmes and sports events on television (World Health Organization, 2012). A promotion activity that occurs on the internet, which connects consumers to companies’ brands and products to stimulate sales (World Health Organization, 2012).</td>
</tr>
<tr>
<td><strong>Sign</strong></td>
<td>Any word, letter, model, banner, placard, board, hoarding, billboard, poster, symbol, emblem, notice, name, image, character, outline, spectacle, display, delineation, announcement, device or representation, or any other means of a similar advertising nature intended to principally attract attention, whether a specially constructed device, structure or apparatus, whether painted, printed, written, carved, inscribed, endorsed or projected onto a place or otherwise fixed or attached to any wall, roof, fence, rock, stone, structure, canvas or stationary vehicle. Aerial signs (for example, blimps) and freestanding signs are included (Hutt City Council, 2014).</td>
</tr>
<tr>
<td><strong>Vending machine – external</strong></td>
<td>Food and beverage marketing seen on the outside of an electronic machine used to dispense a product after money has been put in the machine.</td>
</tr>
</tbody>
</table>

**Product categories and nutrient profiling**

Due to my nutrition training, I led the development of the food product categories and conducted the nutrient profiling work for the Kids’Cam study. As the Kids’Cam study focussed on children’s exposure to non-core (unhealthy) and core (healthy) food marketing, a system of classifying the observed food marketing was
required. Nutrient profiling is “the science of categorising foods according to their nutritional composition” (Scarborough et al., 2007, p. 330). There are many different nutrient profiling models (NPMs) that have been developed to satisfy different purposes (Scarborough et al., 2007). To classify food marketing we required a nutrient profiling model that had been developed specifically for this purpose. The other main criterion for selecting a NPM for this work was that the model had to be simple enough that trained coders could systematically apply the NPM to determine the product category and classification (core/non-core) for each identified instance of food marketing. Therefore, the nutrient profiling model also had to be incorporated into the three-tiered coding framework.

In previous New Zealand research on food marketing, a range of NPMs have been used to classify food marketing to children as healthy or unhealthy. These include the UK Ofcom NPM (Jenkin et al., 2009), the Food Standards Australia and New Zealand Health Claims Nutrient Profiling Calculator (FSANZ calculator) (Barr et al., 2015), the New Zealand Food and Beverage Classification System for Schools (FBCS)(Walton et al., 2009), and the comparison of marketed foods and beverages with National Food and Nutrition Guidelines (Maher et al., 2005). Of these four approaches to classifying food marketing, only the UK Ofcom NPM was specifically designed to assess the suitability of the food and beverage products to be marketed to children.

The FBCS and The National Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2–18 years) were excluded from consideration as possible nutrient profiling methods for Kids’Cam as neither was developed to classify food marketing. The FBCS was developed to classify foods and beverage products sold in school canteens based on the frequency with which they should be consumed, either ‘everyday’, ‘sometimes’ or on an ‘occasional’ basis (Ministry of Health, 2007). The National Food and Nutrition Guidelines for Healthy Children and Young People (Aged 2–18 years) were developed to provide evidence-based
In selecting an appropriate NPM for the Kids’Cam study, I assessed the suitability of four different nutrient profiling models, the UK Ofcom NPM, the FSANZ calculator, a widely-used Australian nutrient profiling method based on the Australian Dietary Guidelines (Hill & Radimer, 1997; Kelly & Chapman, 2007), and the WHO NPM.

**UK Ofcom NPM and the FSANZ calculator**

The strengths and limitations of the UK Ofcom NPM and the FSANZ calculator will be discussed together as the FSANZ calculator was developed from the UK Ofcom NPM and the methods, nutrient threshold values used, and scoring criteria in the FSANZ calculator are very similar to those used in the UK Ofcom NPM.

The UK NPM was developed by the UK Food Standards Agency (FSA) with input from the UK Scientific Advisory Committee on Nutrition, independent nutritionists, dietitians, and industry and consumer representatives (Lobstein & Davies, 2008; Rayner et al., 2009). The model was initially designed as a tool to assess the nutrient profiles of foods advertised to children on television, and it is currently used to regulate the promotion of HFSS foods during children's television programming (Lobstein & Davies, 2008; Rayner et al., 2009). In 2005, the model was handed to Ofcom, the independent UK communications regulatory body, where it is currently used to regulate the advertising and promotion of HFSS foods during children’s television programming (Lobstein & Davies, 2008; Rayner et al., 2009).

The UK Ofcom NPM produces a score for a food or beverage product according to the balance of positive and negative nutrients within the product (Rayner et al., 2009). This score is calculated using the baseline points obtained from the respective amounts of energy (kJ), saturated fat (g), total sugars (g) and sodium (mg) within 100 g/mL of the product (Food Standards Australia & New Zealand,
The score is then modified by the fibre (g), and protein (g) content. The presence of fruits, vegetables, and nuts also positively modify the product’s overall score. Negative nutrients add to the score while positive nutrients and ingredients (present in high concentrations) detract from the overall score. Foods with an overall score of fewer than four points, and beverages with a score of less than one are classified healthy, while foods with a score of four and above, and beverages with a score of one and above are classified as less healthy. Details of the scoring criteria are available elsewhere (Rayner et al., 2009).

The FSANZ calculator was developed alongside Standard 1.2.7 of the Australia and New Zealand Food Standards Code – Nutrition, Health & Related Claims. The calculator was developed to assist regulatory bodies and food manufacturers in Australia and New Zealand to determine the eligibility of foods and beverages to carry health claims (Food Standards Australia & New Zealand, Undated).

In developing the FSANZ calculator, the UK Ofcom NPM model was adapted to include a third category for dairy products. The addition of this category is the main difference between the two models of nutrient profiling. This additional category was introduced to determine whether certain cheese and processed cheese (with calcium content > 320 mg/100 g), edible oils, edible oil spreads, margarine and butter products are eligible to carry a health claim (Food Standards Australia & New Zealand, Undated). Products in this category with a score of less than 28 are eligible to carry a health claim, while those with a score of 28 or above are not. Using the FSANZ calculator, the final score the food product receives determines its eligibility to carry a health claim (Food Standards Australia & New Zealand, Undated).

Key limitations of the Ofcom NPM and the FSANZ calculator are that the nutritional information including the fruit, vegetable, and nut content for each identified product must be collected prior to analysis. As New Zealand food labels are not required to specify the fruit, vegetable and nut content of the product, the researcher would have to estimate this when it is not listed. Further, in New
Zealand, nutrition information panels (NIPs) are not required to display the fibre content of the product, unless a health claim is made about the product’s fibre content (Food Standards Australia & New Zealand, 2015). As such, the fibre content would have to be determined from a different information source. This adds to the burden placed on the researcher as they must collect and individually analyse hundreds of products from specific food categories, estimate the fruit, vegetable, and nut content, and in some cases determine the fibre content. In the context of the Kids’Cam study, this would not be practical.

The misclassification of food products is a further limitation of the Ofcom and FSANZ models. For example, French fries were classified as a healthy food product (or eligible to carry a health claim) owing to their high vegetable content.

**Australian model**

Australian researchers have developed their own category-based NPM from previous research on television food advertising, and the Australian Guide to Healthy Eating (Hill & Radimer, 1997; Kelly & Chapman, 2007). Using this model, food advertising is classified as healthy (core) or unhealthy (non-core). The core categories include all fresh fruits and vegetables (no sugar added); meat and meat alternatives; grains and cereals (including low-sugar and high-fibre breakfast cereals); core foods combined and mixed meals (<250mg/100g sodium); and all low-fat/reduced fat dairy products and alternatives. The non-core categories include fast food; high-sugar drinks (including soft drinks and juices); snack foods; alcohol; ice cream; confectionary; cookies, cakes and pastries; full-fat dairy products and alternatives; and high-sugar, low-fibre breakfast cereals. The model also provides nutrient cut-off values for sugar and fibre in breakfast cereals, and sodium content for the mixed meal category.

The main strength of this model is that it is simple, category-based, and can be readily applied to assess advertised food and beverage products. Unlike the Ofcom NPM and the FSANZ calculator, a wide range of food products can be classified as core or non-core according to their assigned category. This is a
particular advantage as there is no need to collect the nutritional information about most products before they can be classified. For example, using this model, all juices are classified as non-core. Using the Ofcom model or the FSANZ calculator, each time an advertisement for juice appeared in the image, the brand and type of juice would have to be recorded, the nutritional information for this product would then have to be sought and the score determined before the product could be classified as healthy or unhealthy.

Overall the Australian model may provide a more practical method of classifying food advertising for the Kids’Cam study than the Ofcom NPM or the FSANZ calculator. Further it has been used in Australian studies to assess the nature of food marketing to children (Kelly, Bochynska, et al., 2008; Kelly, Cretikos, et al., 2008; Kelly, Halford, et al., 2010; Kelly, King, et al., 2015; Kelly et al., 2007).

**World Health Organization Regional Office for Europe Nutrient Profiling Model**

The WHO NPM was released in January 2015 by the WHO Regional Office for Europe and was developed specifically to aid governments to identify foods that should not be marketed to children (World Health Organization, 2015b), and was therefore highly relevant to the Kids’Cam study. Similar to the Australian model, the WHO NPM is a category-based model that allows for the categorisation of a product as permitted or not permitted to be marketed to children based on the food group to which it belongs. Using the WHO NPM, there are five food categories that are not permitted to be marketed to children, which include chocolate and sugar confectionery, and muesli/energy bars; cakes, biscuits, and fruit pies; fruit juices; energy drinks; and ice-cream, frozen yoghurt, and ice-blocks (World Health Organization, 2015b). The pre-classification of food categories reduces the burden on the researcher to collect and individually analyse hundreds of products from these food categories. As such, the use of this system would be time efficient and less likely to misclassify items than the Ofcom NPM or the FSANZ calculator.

For the remaining 12 food categories, the WHO NPM has set thresholds for the amount of total fat (g), total sugars (g), added sugar (g), non-sugar sweeteners (g),
energy (kJ), saturated fat (g) and trans fatty acids (g) that can be present in 100 g/mL of a product (World Health Organization, 2015b). If the nutrient is present in greater amounts than those specified in the NPM, the food product is not permitted to be marketed to children (World Health Organization, 2015b). Another key advantage of the WHO NPM is that the threshold values allow for quick comparison of the nutritional information of the identified products with the threshold values, and therefore quick classification of the product.

A further advantage of using this model is in the analysis of advertisements for restaurant meals that contain more than one item, for example, a burger meal containing a burger, fries and a drink (World Health Organization, 2015b). Under the WHONPM, each item in the meal must meet the applicable nutrient criteria if the meal is to be permitted to be marketed to children (WHO, 2015). The use of this model would also allow for international comparability as the WHO Regional Office for Europe is urging European member states to adopt this NPM (World Health Organization, 2015b). At the time of developing the coding schedule the WHO NPM appeared to be the best option to address the requirements of the Kids’Cam project.

**Application of the nutrient profiling model and development of the product categories**

The WHO NPM was selected for use in the Kids’Cam study. However, some modifications were required to adapt the profiling model for use in the Kids’Cam study. The WHO NPM has 17 food product categories. The number of codes that could be incorporated into the software for ease of use was limited. Therefore, the number of categories had to be reduced. As such, food product categories were developed in line with previous research on food marketing to children (Chapman et al., 2006; Kelly, Bochynska, et al., 2008; Kelly & Chapman, 2007; Neville et al., 2005), wherein the product category definitions were adapted from Kelly & Chapman (2007), and classification of the food products as core or non-core was conducted using the nutrient cut off values from the WHO NPM. An additional fast
food category was added which included all commercially-prepared food products sold at quick-service restaurants. After much debate among the Kids'Cam team, a collective decision was made that all fast food (including sushi and salad bars) would be classified as non-core as it is typically high in saturated fat and sodium and low in fibre (Lin et al., 1999). We recognised that although sushi outlets and salad bars likely have healthy options available, it was impractical to include these as a separate food category given the constraints of the coding software.

I decided to exclude a small number of food and beverage groups from the coding schedule and analysis. Marketing for fats and oils, baby food and infant formula were excluded on the basis that these foods are not commonly marketed to children. Similarly, slimming products and dietary supplements were excluded from the study on the basis that they are not recommended for consumption in the current New Zealand Food and Nutrition Guidelines for Children and Young People (Ministry of Health, 2012).

Further, jams and other spreads (including peanut butter, nut spreads, and marmite) and all condiments and sauces were excluded from the analysis due to the time taken to code for these products, and the relative unimportance of these products in relation to the research questions. Although spreads and condiments are commonly consumed by New Zealand children (Ministry of Health, 2003), these products do not appear to be heavily marketed to children. Further, international evidence suggest that children are primarily exposed to marketing for high sugar breakfast cereals, savoury snacks, confectionery, soft drinks, and fast foods (Cairns et al., 2013). Kids'Cam was particularly interested in assessing children’s exposure to marketing for high fat, salt, and sugar foods and sweet beverages. The resulting 12 food product categories, their definitions and nutrient cut-off values are shown in Table 6.

As shown in Table 6, there are 11 non-core food product categories and only one core category. Fruit and vegetables, meat and meat alternatives, bread and cereals, milk and milk products, water, and mixed meal dishes were all
categorised as core, in line with the classifications used in Kelly et al. 2007. Following initial coding trials, a consensus was reached among the Kids’Cam team that breaking down the core food category into separate categories would not be practical when coding due to the additional time required and our primary interest in the marketing of HFSS foods. However, non-core dairy and non-core breakfast cereal categories were included in line with the WHO NPM to identify high fat, salt and sugar products within these categories.

All milk and milk alternatives, and cheese were classified as core to reflect our primary interest in the marketing of HFSS foods, and the impact of these foods in particular on children. However, yoghurts and other milk products were seen as having the potential to contribute significant amounts of fat, saturated fat and sugar into a child’s diet and were therefore categorised as core or non-core using the WHO NPM nutrient cut off values. According to the WHO NPM, yoghurts were included in the core category if they contained less than 2.5g of total fat per 100g, less than 2.0g of saturated fat/100g and less than 10g sugar/100g of the product (World Health Organization, 2015b). This excluded a large number of yoghurts that were available on the New Zealand market.

As with yoghurts, there was known to be wide variation in the nutritional value of breakfast cereals. Therefore a non-core breakfast cereal category was created to include cereals that contained >10g fat/100g, >15g total sugars/100g or >1.6g of salt/100g, as per the WHONPM (World Health Organization, 2015b).

As shown in Table 6, sugar-sweetened drinks, fruit juices and drinks, energy drinks, flavoured milk and power additions (e.g. Milo), and sports drinks were all collapsed into one category called sweet drinks. However, an additional category for diet drinks was added as it was seen to be of political importance to distinguish as taxes on sugar-sweetened beverages had gained momentum among the public health community in New Zealand and had entered the public area for debate at the time of this study.

Table 6 Food categories used in annotation
**Food category** | **Product category name**
--- | ---
**Healthy food categories – core foods** |  
Fruits and vegetables and fruit and vegetable products without added sugar: Includes dried fruit, canned, fresh and frozen products. | Core
Meat and meat alternatives: includes fresh meat and fish, legumes, eggs and nuts and nut products (including peanut butter, excluding sugar coated nuts). Includes tinned fish. | Core
Bread and cereals: all bread and cereals, rice, pasta, noodles, crackers; rice crackers; flatbreads; crumpets; instant noodles. Excludes breakfast cereals with >10g total fat, >15g sugar, >1.6g salt/ 100g product. | Core
Core foods combined including frozen meals, soups, sandwiches, mixed salads and homemade international cuisines, homemade sushi and kebabs. | Core
Water (including bottled and non-bottled). | Core
Milk and Milk Products: Includes plain milk, soy, almond, rice, oat milk with, cheese, yoghurts with <2.5g total fat, <2.0g saturated fat, <10g total sugar, <0.2g salt. | Core

**Unhealthy food categories – non-core foods** |  
Ice cream and iced confection: including ice cream, frozen yoghurt, iced lollies and sorbets, frozen dairy desserts. | Ice cream
Chocolate and sugar confectionery (including regular chewing gum). | Confectionery
Fast food restaurants/ meals. | Fast food
Cakes, muffins, sweet biscuit, pies and pastries. | Cookies, cakes, and pastries
Non-core dairy: Yoghurt, diary food and custard with > 2.5g total fat, >2.0 saturated fat, > 10g sugar > 0.2g salt/ 100g product, custard. | Non-core dairy
Sweet drinks – including soft drinks, cordials, electrolyte drinks and flavour additions (e.g. Milo), flavoured milk, fruit drinks, fruit juice (including 100% fruit juice), flavoured waters, iced tea, energy drinks, and liquid breakfasts. | Sugary drinks and juices
Diet Drinks – Artificially sweetened drinks. | Diet drinks
Snack foods - crisps, extruded snacks popcorn, snack bars, muesli and nut bars, sugar coated nuts, sugar-sweetened fruit and vegetable products including jelly fruit cups, fruit straps or leathers. | Snack foods
Processed meat, poultry, fish and similar. Including sausage, ham, bacon; chicken nuggets; smoked and pickled fish; fish fingers and breaded/ battered fish with > 20g total fat, >1.7 g salt/ 100g of product. | Processed meats
Frozen/ fried potato products. | Other
Non-core breakfast cereals: includes cereals with > 10g total fat, >15g total sugar, > 1.6g salt/ 100g of product. | Non-core breakfast cereals.

**Nutrient profiling of yoghurt and breakfast cereals**

This section describes the nutrient profiling of the yoghurts and breakfast cereals that I conducted.

To identify the brands and products with the largest brand shares of the New Zealand market both for yoghurts and breakfast cereals, data from Euromonitor International was used (Euromonitor International, 2015a; Euromonitor International, 2015b). These data revealed that in 2015, the New Zealand market
was dominated by 19 breakfast cereal brands and 18 yoghurt brands. The nutritional information for each product within the product’s range for each brand was then collected from product websites and analysed using the criteria outlined in Table 6. In addition to the Euromonitor International data, a list of all available yoghurt and breakfast cereals was obtained from the Countdown (one of two major supermarket chains in New Zealand and the only one with online shopping) website to ensure that all major brands and products within each of the product ranges had been included and analysed. Once the products had been assessed using the criteria outlined in Table 6, all of the products that were classified as core were collated into a table and images of each of these products were gathered from product websites and Google Images. The product name and corresponding images were then provided to each coder as part of the Kids’Cam Annotation Protocol to ensure that coders could identify healthy ‘core’ and unhealthy ‘non-core’ breakfast cereals and yoghurt products (Appendix 7). If the identified product was not included in the glossary of core breakfast cereals, the product was annotated with a non-core breakfast cereal product category code. Similarly, if the identified yoghurt product was not present in the glossary of core yoghurt products, the product was annotated with the non-core dairy code. The product glossaries for breakfast cereals and yoghurts contained the core, rather than the non-core products, as there were fewer core than non-core products on the market for both food product categories.

**Nutrient profiling of brands**

In addition to individual products, brands were also assessed and categorised as core or non-core. Food brands have been defined as

a brand in respect of a food product or food range; the name of a manufacturer of a food products or food range; or the name of a food range, or any other words, designs or images, or combination of words, designs or images, that are closely associated with a food range. (World Health Organization, 2012, p. 51).
The nutritional information for the product ranges of 200 major New Zealand grocery brands was extracted from the Nutritrack database\(^2\) (http://www.foodandhealth.auckland.ac.nz/en/about/news/news-2014/2014/05/nutritrack.html). After this information had been collected, the nutrient profiles of the products within a brand’s product range were categorised as core or non-core according to the criteria outlined in Table 6. If greater than 50% of the products within a brand’s product range were classified as core, the brand was categorised as core. If more than 50% of the products within the product range were not permitted, the brand was classified as non-core. The list of the analysed brands and their categorisations was provided to all coders and is included in Appendix 8.

In all, I analysed and classified a total of 5094 individual products from 200 grocery brands and 15 fast food chains according to the criteria outlined in Table 6. In addition to the Kids’Cam Annotation Protocol each coder was provided with a glossary of 242 top New Zealand food and beverage brands and logos (data sourced from Euromonitor International) to refer to if they were unsure what brand or product an identified logo represented. I developed this glossary (available on request).

\(^2\) The Nutritrack database contains information on the nutrient composition of the majority of processed foods on sale at New Zealand supermarkets and major fast food restaurants.
Image coding protocol

To reduce ambiguity regarding how each image was coded, a Kids’Cam Annotation (Coding) Protocol containing the above definitions, instructions on what to look for in the images and detailed coding rules was developed by MS, LS, TC, and me.

The Kids’Cam Annotation Protocol is attached as Appendix 9 and provides a detailed account of the coding process and the associated rules that guided content analysis of the image data. This section provides a brief overview of the image coding protocols and rules. Each image was coded manually using DCU’s bespoke annotation software. As discussed above, using this coding tool, each image that contained food marketing was assigned a setting, marketing medium and food product category code.

The Kids’Cam food marketing study, including this thesis, aimed to quantify the frequency of children’s exposures to food marketing. For image coding, we defined a marketing exposure (advertising exposure for my thesis) to be from the time one instance of food marketing for one product or brand appeared in an image until it was followed by three consecutive images where the marketing was completely absent.

Instances of food marketing were only coded when there was at least 50% of a logo or brand name clearly visible in the image. There was a consensus among the research team that this rule was necessary to reduce the risk of misidentification and misclassification of each instance of marketing. In a sequence of images containing food marketing, the marketing encounter began from the first image containing at least 50% of a food brand or logo and was considered finished when there were three consecutive images without the product name, logo or associated branding.

Where there were multiple different instances of food marketing in an image, each instance of marketing was coded with the setting, a marketing medium, and
product category. For example, using the coding schedule the outdoor food advertising in Figure 13 was assigned the following codes,

(a) shop front>sign>ice cream,

(b) shop front>sign>sugary drinks and juices 2, and

(c) street>sign>ice cream.

![Example image with multiple codes](image)

**Figure 13 Example image with multiple codes**

Where multiple instances of marketing were identified in the same setting with the same marketing medium, the product category was only recorded once. For example, in Figure 13, there are three shop front signs for Coca-Cola. This was considered one encounter with the Coca-Cola brand. Where there were multiple instances of food marketing for different brands in the same product category, this is reflected by the addition of a number. In the example given in Figure 13 there are two advertisements for sugary drinks (Coca-Cola and V energy drink) as such this image was coded with shop front>sign>sugary drinks and juices 2.
Where multiple instances of marketing for the same brand or product occurred in more than one setting or via more than one marketing medium in the images, these instances were coded for separately. For example, in Figure 13, the two advertisements for Tip Top ice cream were coded as separate exposures as they occurred in different settings (shop front and street). The definition of shop front used in this study (displayed in Table 4) did not include sandwich boards. Sandwich boards were considered part of the street setting.

When images were captured inside supermarkets, convenience stores, and other food retail stores, a large number of marketing exposures were captured in each image. Examples of typical images from supermarkets and convenience stores are displayed in Figure 14. There was a consensus among the research team that it would be too time-consuming to code for each marketing exposure inside supermarkets and convenience stores. Therefore, images captured in these settings were coded for their setting, in-store marketing (marketing medium) and either supermarket or convenience store as the product category code. For example the images in Figure 14 were coded as follows,

- Supermarket - indoor > in-store marketing > supermarket 1
- Convenience store - indoor > in-store marketing > convenience store 1.

Figure 14 Supermarket and convenience store images

Coding the supermarket and convenience stores in this manner excluded them from the initial Kids’Cam analysis as the codes did not provide information about
the nature of the marketing medium or product categories that children encountered in this setting. However, the marketing in convenience stores has been analysed subsequently by Christina Mckerchar (CM) as part of her related PhD research on food availability using the Kids’Cam data.

To code the large data set, four research assistants were employed to aid TC and me as there was a need to complete the data analysis in a timely fashion to complete the Kids’Cam study in the allotted two year period and report back to the Health Research Council, our funder.

The image data were evenly distributed between me, Richard Kennedy (RK), Saskia Campbell (SC), Ryan Cullen (RC), Ryan Gage (RG). Although my primary interest in the data was the outdoor settings, all coders coded all of the data collected by their allocated participants. As such, each coder coded for data in all settings except the school setting which had been coded previously by a group of fourth-year medical students during their public health project and checked by Ryan Gage.

I manually coded the data from 156 days from 140 children. This included 140 Fridays before and after school, six full Saturdays, and 10 Thursdays before and after school. Each day of a child’s data took approximately three hours to code. In total, I spent 12 weeks coding the image data.

**Inter-coder reliability**

To ensure that image coding was conducted consistently and accurately across all coders, reliability tests were performed before coders could begin their work. Before the test, a half-day training session was held with all coders to go through the annotation rules and protocols contained within the Kids’Cam Annotation Protocol. Coders were then given access to the dataset for several days to become familiar with it and how the coding rules were applied. Once all coders were confident in applying the annotation rules and protocols, MS, TC, SC, RK, RC, RG and I were each allocated a test dataset of 115 images. The test dataset contained
individual images and sequences of images that were designed to test our application of the coding rules.

Images were then coded by each coder individually according to the Kids’Cam Annotation Protocol. Coders were required to achieve 90% agreement with the gold standard coder (either TC or me) before they were able to begin coding the Kids’Cam data set. Before coding the test dataset, all coders were required to familiarise themselves with the Annotation Protocol. When a coder achieved an agreement score of less than 90%, they were subsequently allocated a new test set of images and were required to take a new test. The process was repeated until the coder was able to achieve 90% agreement with the gold standard coder. The image data sets were developed by TC and me and included a range of images to test the coders understanding and application of the image coding definitions and rules. I performed an inter-rater reliability test on a set of images that had been selected by TC. I achieved greater than 90% agreement with his codes.

**BMI categories**

Children were assigned to one of six BMI categories (by me), determined by their age and gender-specific BMI values. These values were calculated using the Extended International (IOTF) Body Mass Index Cut-Offs for Thinness, Overweight and Obesity in Children and were entered into the Kids’Cam demographic information spreadsheet (Cole & Lobstein, 2012). As discussed in Chapter Two, these cut-offs represent children’s BMI as it corresponds to their predicted BMI at 18 years (Cole & Lobstein, 2012). For ease of statistical analysis in my thesis and Kids’Cam, the six BMI categories were collapsed into the following three categories: healthy/underweight (BMI values ≥16.0 and <25.0), overweight (BMI values ≥25.0 and <30.0), and obese (BMI values ≥30.0).
Statistical analysis

This section outlines the methods of statistical analysis used to answer the central research question in this thesis, what is the extent and nature of children’s exposure to outdoor food and beverage advertising and the following sub research questions:

1. What is the extent and nature of children’s exposure to core and non-core outdoor food advertising?
   a) How does this vary by ethnicity and school decile, BMI category, and gender?

2. What is the extent and nature of children’s exposure to core and non-core outdoor food advertising on their journeys to and from school?
   a) How does this vary by ethnicity and school decile, BMI category, and gender?

3. What are the most frequently advertised non-core food product categories?
   a) In all outdoor settings, and
   b) On the journey to and from school.

Methods of statistical analysis used to answer research questions 1, 1 (a), and 3 (a).

This section outlines the methods of statistical analysis used to determine the extent and nature of children’s exposure to core and non-core outdoor food advertising. The sample of data used in the analysis for this thesis differed from that used in the Kids’Cam study, as it was limited to the data collected in outdoor settings. Only data that had been coded with the following setting codes were included in the statistical analyses for this thesis: street, shop front, fresh food market, sport, outdoor recreation space, public transport facility, and service station-on-site. However, the definition of sports setting included swimming pools, indoor and outdoor sports stadiums, sports clubrooms as well as sports grounds. As such, this may lead to an overestimate of children’s advertising exposure in the sports setting as some of the advertising exposures may have been captured in indoor sports settings in addition to sports grounds. As this
thesis used the Kids’Cam coding schedule, the inclusion of these indoor settings under the sports code was unavoidable. Participant datasets were excluded from the statistical analysis if they did not have a minimum of one image coded with an outdoor setting code.

**Descriptive statistics**

All statistical analyses were conducted using Stata 14 (StataCorp, College Station, Tx). Descriptive statistics were calculated for the sample, describing participating children by gender, age, ethnicity, age and gender-specific BMI category and school decile stratum. Initial descriptive statistics were also calculated to describe the median number of images collected by the children by ethnicity and school decile stratum. The proportion of time spent in each outdoor setting by gender, ethnicity and school decile stratum were also calculated and reported as a proportion of overall time spent outdoors.

**Calculation of outdoor food advertising exposure rates**

Initially, prevalence of exposure to core and non-core advertising were calculated for each child by taking the number of exposures to core and non-core advertising and dividing these by the total number of images captured in outdoor settings. The prevalence was re-scaled and reported as rates of core and non-core exposure per hour of outdoor data. The median exposure rates are reported by ethnic group, school decile strata, and BMI category, and gender. The complex sampling design was accounted for in all analyses using Stata’s svy prefix commands to allow for the clustered nature (by school) of the data and apply weighting options. The latter was necessary to account for the oversampling of Māori and Pacific and the under-sampling of NZ European children, relative to their share of the Year 8 population in the Wellington region. I calculated the median rates of exposure to non-core and core advertising per hour spent outdoors for each outdoor setting, and by food product category. I also calculated the median rates of exposure to non-core and core food advertising by setting and food product category for each demographic group.
I calculated median exposure rates to investigate variation in outdoor food advertising exposure between participants. The median exposure rates are presented as the proportion of the sample with low, medium and high rates of food advertising exposure per hour spent in outdoor settings. There are no available threshold values for low, medium and high levels of exposure to outdoor food advertising. Therefore, for the purposes of this work, low rates of exposure were defined as <1 exposure per hour spent in outdoor settings, moderate exposure rates will be ≥1 and <5 exposures per hour, and high rates of exposure will be ≥5 exposures per hour.

**Regression methods**

I conducted subsequent analyses of non-core and core exposure rates using Poisson regression methods. Poisson regression was selected as it is commonly used to model count data (Cameron & Trivedi, 2013), such as the data produced from the Kids’Cam study. Non-core and core food advertising exposure rates were modelled separately with results presented as mean rates of exposure with 95% confidence intervals (95%CI) per hour spent in outdoor settings. Person-time was specified in these Poisson regression models as the duration of photos per child; for this person-time denominator, each photo was treated as representing 7 seconds of exposure time (the median interval between images). To determine the overall duration of time the camera was worn for each day, every image was assigned a set of three codes. As per the three-tiered coding framework (Table 3) images without food marketing were still coded with a setting, a ‘default’ code for marketing medium and a ‘default_1’ code for product category.

Mean rates and 95% confidence intervals of non-core and core advertising exposure were calculated for each gender, ethnicity, school decile stratum and BMI category. Rate ratios were calculated to compare mean rates between ethnic groups, school decile strata and different BMI categories. Within each of these analyses, the NZ European group, low decile school strata and healthy BMI category were the reference groups. Rate ratios are presented with 95%
confidence intervals alongside the p-value results from hypothesis testing. Results are presented for each stratified group.

Mean rates of exposure to core and non-core advertising were calculated for each outdoor setting and demographic variable. Rate ratios were also calculated to compare exposure rates between ethnic groups, school decile stratum and BMI category. The same analyses were performed to calculate rates of non-core exposures to advertising by food product category.

The data were not analysed to assess outdoor food advertising exposure by marketing medium as the only marketing medium of interest in this thesis was signs. The definition of sign used in this thesis includes any word, letter, model, banner, placard, board, hoarding, billboard, poster, symbol, emblem, notice, name, image, character, outline, spectacle, display, delineation, announcement, device or representation, or any other means of a similar advertising nature intended to principally attract attention, whether a specially constructed device, structure or apparatus, whether painted, printed, written, carved, inscribed, endorsed or projected onto a place or otherwise fixed or attached to any wall, roof, fence, rock, stone, structure, canvas or stationary vehicle. Aerial signs (for example, blimps) and freestanding signs are included (Hutt City Council, 2014, p. 18).

All other marketing mediums were excluded from the analysis to reflect the primary interest in fixed forms of advertising in outdoor settings.

**Adjusted models of analysis**

As discussed in Chapter three, the literature suggests that outdoor food advertising exposure is patterned by socioeconomic position and ethnicity. As such, adjusted Poisson regression models were applied to the data to assess advertising exposure by ethnicity, controlling for school decile stratum, and to assess outdoor advertising exposure by school decile strata, independent of ethnicity.
Statistical analysis methods used to answer research questions 2, 2 (a), and 3 (b)

This section outlines the methods of statistical analysis I used to determine the extent and nature of children’s exposure to core and non-core outdoor food advertising on the journey to and from school.

The sample of data used in this analysis was that from before and after school on Thursdays and Fridays. Data for the journey to school included all images annotated with an outdoor setting from the time participants left home as indicated by the first non-home image (annotated with any setting other than home) and the time they arrived at school (as indicated by the school annotation). The journey home included all data from the first non-school image until the first image annotated with the home setting. The data from both journeys was analysed as one data set with the assumption that there was no important difference between the two daily journeys or between the two school days. Other activities that were conducted indoors during the journey to or from school, for example entering a convenience store, were excluded from the analysed data set. Some journeys to or from school included mixed modes of transport. For participants who used public transport or private transport to get to school, only images from their journeys that were annotated with an outdoor setting were included in the analysis. Therefore, the data set excluded any food advertising present within cars, buses, or trains to reflect my primary focus on outdoor settings.

The methods of data analysis used to calculate rates of exposure to non-core and core advertising on the journey to and from school were identical to those outlined above with notable exceptions. Results of these analyses are presented as rates of exposure to core and non-core advertising per journey (trip) to or from school.
**Adjusted models of analyses**

The adjusted Poisson regression models were not applied to determine the adjusted rates of advertising exposure by outdoor setting, or the rates of exposure to non-core advertising by food product type on the journey to or from school. This was due to the limited number of exposures captured in the dataset and the relatively small number of children with school trip data.

**Chapter Summary**

This chapter has described the study design, sampling strategy and recruitment methods used in this study. It has also described the methods of data collection, content analysis and nutrient profiling, as well as the methods of statistical analysis used to quantify the extent and nature of children's exposure to food advertising in outdoor settings and on children’s journeys to and from school. The results of this study are presented in the following two chapters.
Chapter Six: Results children’s exposure to outdoor advertising

Introduction

This chapter presents the results of the analyses conducted to determine the extent and nature of children’s exposure to outdoor food advertising across all outdoor settings in which they spent time. The chapter begins with a description of the demographic characteristics of the Kids’Cam study participants’ and the main findings from Kids’Cam. All sections thereafter present the results on outdoor advertising. The first section describes the demographic characteristics of the participants included in the analysis of outdoor food advertising exposure for this thesis. The second describes the amount of data participants collected and where they spent their time. Next, the individual exposure rates are reported to examine individual variation in number and types of advertising exposures recorded by the participants. Fourth, the overall rates of exposure to non-core and core advertising in outdoor settings are presented by ethnic group, school decile strata, BMI category, and gender group. Mean advertising exposure rates by outdoor setting are then presented. Lastly, the mean rates of non-core food advertising exposures are reported by food product category.

Kids’Cam results

Sociodemographic characteristics of Kids’Cam sample

The sociodemographic characteristics of the Kids’Cam participants are displayed in Table 7 as are the details of the participating schools. Overall, 168 children participated in Kids’Cam. Similar numbers of NZ European and Māori children participated while fewer Pacific children took part. Children from low decile schools were most numerous followed by those from medium and high decile schools. The majority (75.3%) of children who took part were 12 years old and
female (52.7%). Over half (52.5%) of the children had an NZiDep score of 1 or 2, indicating low levels of relative individual socioeconomic deprivation, with the remaining children split evenly between scores 3, 4, and 5. The majority (57.5%) of participants were underweight or a healthy weight for their age, gender, and height, with the remaining participants classified as either overweight or obese. As shown in Table 7, there were a similar number of schools recruited from each of the four cities in the Wellington region. All of the participants completed data collection.

**Kids’Cam main findings**

Table 8 presents the overall mean rates of core and non-core food marketing\(^3\) exposures per day (with 95% CI from Poisson regression). Displayed in this table are also the mean rates of core and non-core marketing exposures by setting, marketing medium, and food product category. The rates per day are displayed as the mean number (95%CI) of exposures to marketing per 10 hours of image data.

Overall, children were exposed to a mean of 27.3 (95%CI 24.8 to 30.1) non-core and 12.3 (95%CI 8.7 to 17.4) core marketing exposures per day. As shown in Table 8, both non-core and core marketing exposures were most numerous in the home, school and public space settings. Notably, 30.4% of all non-core advertising exposures occurred in public spaces. Exposures to marketing for sugary drinks, fast food, confectionery, snack foods and ice cream were the most common in this sample.

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\(^3\) The term marketing is used to describe exposures in this section as Kids’Cam sought to quantify children’s exposure to marketing via product packaging, signs, instore marketing, print media, screens and merchandise. In this thesis, the term advertising is used to reflect my primary interest in outdoor advertising via signage only.
### Table 7 Sociodemographic and other characteristics of Kids’Cam participants and schools

<table>
<thead>
<tr>
<th>Sociodemographic variable</th>
<th>Group</th>
<th>N (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Child participants (total n = 168)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td>NZ European</td>
<td>66 (39.3)</td>
</tr>
<tr>
<td></td>
<td>Māori</td>
<td>60 (35.7)</td>
</tr>
<tr>
<td></td>
<td>Pacific</td>
<td>42 (25.0)</td>
</tr>
<tr>
<td>School decile</td>
<td>Low (1-3)</td>
<td>62 (36.9)</td>
</tr>
<tr>
<td></td>
<td>Medium (4-7)</td>
<td>55 (32.7)</td>
</tr>
<tr>
<td></td>
<td>High (8-10)</td>
<td>51 (30.2)</td>
</tr>
<tr>
<td>Age (years)*</td>
<td>11</td>
<td>13 (8.0)</td>
</tr>
<tr>
<td></td>
<td>12</td>
<td>122 (75.3)</td>
</tr>
<tr>
<td></td>
<td>13</td>
<td>26 (16.1)</td>
</tr>
<tr>
<td></td>
<td>14</td>
<td>1 (0.6)</td>
</tr>
<tr>
<td>Gender</td>
<td>Female</td>
<td>88 (52.7)</td>
</tr>
<tr>
<td></td>
<td>Male</td>
<td>80 (47.3)</td>
</tr>
<tr>
<td>NZiDep *</td>
<td>1</td>
<td>52 (32.1)</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>33 (20.4)</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>25 (15.4)</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>26 (16.1)</td>
</tr>
<tr>
<td></td>
<td>5</td>
<td>26 (16.1)</td>
</tr>
<tr>
<td>BMI**</td>
<td>Underweight</td>
<td>9 (5.4)</td>
</tr>
<tr>
<td></td>
<td>Healthy</td>
<td>87 (52.1)</td>
</tr>
<tr>
<td></td>
<td>Overweight</td>
<td>46 (27.5)</td>
</tr>
<tr>
<td></td>
<td>Obese</td>
<td>25 (15.0)</td>
</tr>
<tr>
<td><strong>School details (n=16)</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Location</td>
<td>Wellington</td>
<td>6 (37.5)</td>
</tr>
<tr>
<td></td>
<td>Porirua</td>
<td>6 (37.5)</td>
</tr>
<tr>
<td></td>
<td>Hutt Valley</td>
<td>4 (25.0)</td>
</tr>
<tr>
<td>School decile***</td>
<td>Low (1-3)</td>
<td>7 (43.8)</td>
</tr>
<tr>
<td></td>
<td>Medium (4-7)</td>
<td>3 (18.8)</td>
</tr>
<tr>
<td></td>
<td>High (8-10)</td>
<td>6 (37.5)</td>
</tr>
</tbody>
</table>

* Age and NZiDep missing for 6 participants (questionnaire not completed)
** BMI missing for 1 participant as child declined to be measured
*** Some schools were sampled multiple times for a particular ethnicity/school decile stratum in accordance with sampling probability-proportional-to-size.

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4 Table adapted with permission from Signal et al. (2017).
Table 8 Mean rate of core and non-core food marketing exposures (per day, with 95% CI, from Poisson regression) for total exposures (across all settings/media) and by setting, medium, and product category (with percentage share of all exposures by setting/medium/product category)\(^5\)

<table>
<thead>
<tr>
<th>Total/Setting/Medium</th>
<th>Non-core foods</th>
<th>Core foods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate per day* (95% CI)</td>
<td>% of total</td>
</tr>
<tr>
<td>Total (any setting/marketing medium)</td>
<td>27.3 (24.8, 30.1)</td>
<td>100</td>
</tr>
<tr>
<td>Setting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Home</td>
<td>8.9 (7.9, 10.1)</td>
<td>32.8</td>
</tr>
<tr>
<td>School</td>
<td>5.3 (4.2, 6.8)</td>
<td>19.5</td>
</tr>
<tr>
<td>Food venues**</td>
<td>2.7 (1.5, 4.7)</td>
<td>9.7</td>
</tr>
<tr>
<td>Recreation venues***</td>
<td>2.1 (1.1, 3.8)</td>
<td>7.6</td>
</tr>
<tr>
<td>Other public spaces****</td>
<td>8.3 (6.0, 11.4)</td>
<td>30.4</td>
</tr>
<tr>
<td>Marketing medium</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product packaging</td>
<td>17.4 (15.7, 19.4)</td>
<td>63.9</td>
</tr>
<tr>
<td>Sign</td>
<td>7.6 (5.3, 10.9)</td>
<td>27.9</td>
</tr>
<tr>
<td>Instore marketing</td>
<td>1.0 (0.7, 1.4)</td>
<td>3.6</td>
</tr>
<tr>
<td>Print media</td>
<td>0.6 (0.2, 1.8)</td>
<td>2.2</td>
</tr>
<tr>
<td>Screen</td>
<td>0.2 (0.1, 0.4)</td>
<td>0.6</td>
</tr>
<tr>
<td>Merchandise</td>
<td>0.5 (0.2, 1.2)</td>
<td>1.9</td>
</tr>
<tr>
<td>Product category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Core</td>
<td>12.3 (8.7, 17.4)</td>
<td>100</td>
</tr>
<tr>
<td>Sugary drinks</td>
<td>9.1 (8.3, 10.0)</td>
<td>33.4</td>
</tr>
<tr>
<td>Fast food</td>
<td>6.0 (4.7, 7.6)</td>
<td>22.1</td>
</tr>
<tr>
<td>Confectionery</td>
<td>3.0 (2.3, 4.0)</td>
<td>11.1</td>
</tr>
<tr>
<td>Snack foods</td>
<td>2.9 (2.4, 3.5)</td>
<td>10.5</td>
</tr>
<tr>
<td>Ice cream</td>
<td>1.9 (1.3, 2.7)</td>
<td>7.0</td>
</tr>
<tr>
<td>Diet soft drinks</td>
<td>1.4 (0.9, 1.9)</td>
<td>4.9</td>
</tr>
<tr>
<td>Cookies/cakes/pastries</td>
<td>1.3 (0.9, 2.0)</td>
<td>4.8</td>
</tr>
<tr>
<td>Milk product (unhealthy)</td>
<td>0.8 (0.4, 1.3)</td>
<td>2.8</td>
</tr>
<tr>
<td>Cereal (unhealthy)</td>
<td>0.7 (0.4, 1.1)</td>
<td>2.5</td>
</tr>
<tr>
<td>Other</td>
<td>0.2 (0.1, 0.4)</td>
<td>0.9</td>
</tr>
</tbody>
</table>

* Rate of marketing exposures per day (calculated as the rate per 10 hours of photographs).
** Includes Fast food indoor, Full-service restaurant, and Fresh food market.
*** Includes Sport, Outdoor Recreation, and Community venue
**** Includes Street, Shop front, Shopping mall, Private transport, Public transport facility, Onboard public transport, and Other retail.

\(^5\)Table adapted with permission from Signal et al. 2017.
Children’s exposure to outdoor advertising

The remaining sections in this chapter present the results of the analyses conducted to determine children’s exposure to outdoor food advertising. As discussed in Chapter Two, outdoor advertising includes all promotions that occur in outdoor settings via billboards (including mobile billboards), signs (including printed, painted and digital signs), posters, sandwich boards, flags and banners (Upper Hutt City Council, 2017). In Kids’Cam and this thesis, all of the possible outdoor marketing mediums were collapsed into the ‘sign’ marketing medium category for ease of analysis. As such, the analyses presented in this chapter is for food and beverage advertising that was coded with following outdoor settings: street, shop front, fresh food market, sport, outdoor recreation space, public transport facility, service station-on-site, and the sign marketing medium code. The definitions for each of the outdoor settings and the sign marketing medium can be found in Table 4 and Table 5, respectively.

Demographic characteristics of the study sample

The analysis for this thesis included data from 161 of the Kids’Cam participants, as seven children did not collect any data in outdoor settings. Table 9 displays the demographic characteristics of the study participants who had data in outdoor settings. The mean age (±SD) of the sample was 12.6 ±0.5 years. The sample of participants included a similar proportion of males (46.6%) and females (53.4%), and similar proportions of NZ European (39.1%), and Māori (36.7%) children, and a smaller proportion of Pacific (24.2%) children. Over half (56.9%) of the sample had a healthy BMI for age and height, over a quarter (27.5%) of the sample were classified as overweight, and just under one-sixth (15.6%) were classified as obese. As indicated in Table 9, five children did not provide demographic information. As age was required to determine children’s BMI category, BMI values were calculated for these children using the mean age of the sample, 12.6
years. The sample included children from low (school decile 1-3), medium (4-7) and high (8-10) decile schools in similar proportions.

Table 9 Demographic characteristics of the study participants

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>161</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>75</td>
<td>46.6</td>
</tr>
<tr>
<td>Female</td>
<td>86</td>
<td>53.4</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>13</td>
<td>8.3</td>
</tr>
<tr>
<td>12</td>
<td>119</td>
<td>76.3</td>
</tr>
<tr>
<td>13</td>
<td>23</td>
<td>14.7</td>
</tr>
<tr>
<td>14</td>
<td>1</td>
<td>0.6</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td>12.6 ±0.5</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>156¹</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>63</td>
<td>39.1</td>
</tr>
<tr>
<td>Māori</td>
<td>59</td>
<td>36.7</td>
</tr>
<tr>
<td>Pacific</td>
<td>39</td>
<td>24.2</td>
</tr>
<tr>
<td>Total</td>
<td>161</td>
<td></td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy/underweight</td>
<td>91</td>
<td>56.9</td>
</tr>
<tr>
<td>Overweight</td>
<td>44</td>
<td>27.5</td>
</tr>
<tr>
<td>Obese</td>
<td>25</td>
<td>15.6</td>
</tr>
<tr>
<td>Total</td>
<td>160²</td>
<td></td>
</tr>
<tr>
<td>School stratum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>57</td>
<td>35.4</td>
</tr>
<tr>
<td>Medium</td>
<td>53</td>
<td>32.9</td>
</tr>
<tr>
<td>High</td>
<td>51</td>
<td>31.7</td>
</tr>
<tr>
<td>Total</td>
<td>161</td>
<td></td>
</tr>
</tbody>
</table>

¹ Demographic information was not available for five participants
² One child declined to have their height and weight measured

Amount of image data participants collected

There was wide variation in the number of images collected by participants in outdoor settings. As displayed in Table 10, participants collected between 1 and 4368 images across the four-day data collection period. Participants collected a median of 379 images. Assuming a 7-second interval between image capture, this equates to a median of 44.2 minutes in outdoor settings during the four-day data collection period. The majority of children collected between 13.4 and 102.4 minutes of outdoor data over the four day period. The median number of images collected and the median recording duration are highlighted in Table 10.
There were notable differences in the number of images collected in outdoor settings (and therefore the amount of time children wore the cameras in those settings) by ethnic group and school decile stratum. As shown in Table 11 NZ European children and those from the high decile school strata captured the greatest number of images over the four-day data collection period.

### Table 10 Number, equivalent duration (minutes) and distribution of images collected during four day data collection period

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>Total recording duration (minutes)</th>
<th>Total number of images</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0.12</td>
<td>1</td>
</tr>
<tr>
<td>Lower quartile</td>
<td>13.4</td>
<td>115</td>
</tr>
<tr>
<td>Median</td>
<td>44.2</td>
<td>379</td>
</tr>
<tr>
<td>Upper quartile</td>
<td>102.4</td>
<td>878</td>
</tr>
<tr>
<td>Maximum</td>
<td>509.6</td>
<td>4368</td>
</tr>
</tbody>
</table>

### Table 11 Median number of images collected in outdoor settings over four days by ethnic group and school decile

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Median number of images</th>
<th>Median recording duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>592</td>
<td>69.1</td>
</tr>
<tr>
<td>Māori</td>
<td>240</td>
<td>28.0</td>
</tr>
<tr>
<td>Pacific</td>
<td>402</td>
<td>46.9</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>354</td>
<td>41.3</td>
</tr>
<tr>
<td>Medium</td>
<td>273</td>
<td>31.9</td>
</tr>
<tr>
<td>High</td>
<td>479</td>
<td>55.9</td>
</tr>
</tbody>
</table>

**Proportion of time spent in each outdoor setting**

This section describes the proportion of time children spent in each outdoor setting by key demographic variables. The mean proportion of time participants spent in each outdoor setting is presented, rather than the average amount of time spent in each setting, as there was wide variation in the amount of outdoor setting data each participant collected over the four-day data collection period. Further, there was considerable inter-participant variation in the amount of data collected in outdoor settings. As such, a calculation of the average amount of time spent in
each setting was unlikely to provide meaningful information about the amount of time the participants spent in each setting.

Table 12 presents the mean proportion of time children spent in each outdoor setting over the data collection period. On average, children spent the greatest proportion of their time in the street setting and similar proportions of time in outdoor recreation and sports settings. Children recorded a mean of 4.4% of their images in the shop front setting. Children spent the lowest proportion of their time at fresh food markets and service station forecourts. However, it is worth noting that children were instructed to remove their camera and GPS device before engaging in sporting activities to minimise the risk of injury to the participant and those playing the game and to protect the equipment from damage. Therefore, the reported proportion of time children spent in sports settings is likely to be an underestimate.

<table>
<thead>
<tr>
<th>Setting</th>
<th>Mean proportion of time spent in each outdoor setting (95% CIs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Street</td>
<td>67.2 (62.2-72.2)</td>
</tr>
<tr>
<td>Outdoor Recreation</td>
<td>13.2 (9.3-17.0)</td>
</tr>
<tr>
<td>Sport</td>
<td>12.8 (9.0-16.6)</td>
</tr>
<tr>
<td>Shop front</td>
<td>4.4 (3.0-5.7)</td>
</tr>
<tr>
<td>Public transport facility</td>
<td>1.3 (0.4-2.3)</td>
</tr>
<tr>
<td>Fresh food market</td>
<td>0.9 (0.0-1.8)</td>
</tr>
<tr>
<td>Service station</td>
<td>0.2 (0.0-0.5)</td>
</tr>
</tbody>
</table>

**Gender**

The proportion of time spent in each outdoor setting varied by gender, ethnicity and school decile stratum. The mean proportion of time male and female participants spent in outdoor settings is displayed in Figure 15. On average, female participants spent a lower proportion of their outdoor time in the street setting than male participants. However, females spent a greater proportion of time in both the outdoor recreation and sports settings than male participants (as shown in Figure 15). Both groups spent a similar proportion of time in the shop front setting. Interestingly, on average, male participants spent a greater proportion of their time (4.4%) at public transport facilities than female
participants (1.4%). Male participants also spent a larger proportion of their time at fresh food markets (1.6%) than female participants (0.6%).

![Figure 15 Mean proportion of time spent in each outdoor setting by gender](image)

**Ethnicity**

Presented in Figure 16 are the mean proportions of time spent in outdoor settings for each ethnic group. Participants from all ethnic groups spent the majority of their time outdoors in the street setting. On average, the proportion of time spent on the street, in outdoor recreation and sports setting were similar across the three ethnic groups. However, the average proportion of time spent in the shop front setting was higher among Māori (5.3%) and Pacific (4.5%) than NZ European (3.2%) children. NZ European participants spent a greater proportion of their time in public transport facilities (4.1%) than Māori (0.3%) and Pacific (0.9%) children, suggesting that NZ European children used public transport more frequently than Māori and Pacific children. Pacific children spent a larger proportion of time at fresh food markets (2.7%) than NZ European (1.0%) and
Māori (0.5%) participants. The proportion of time spent at service station forecourts was low across all groups.

![Bar chart showing mean proportion of time spent in each outdoor setting by ethnicity.](image)

**Figure 16 Mean proportion of time spent in each outdoor setting by ethnicity**

**School decile stratum**

Notable differences in the proportion of time spent in each setting were also observed among school decile strata. As shown in Figure 17, children in the medium decile strata spent a greater proportion of time in the street setting than children from the low and high decile strata. Participants from schools in the high decile strata spent a greater proportion of their time in the sports setting than those in the middle and low decile strata. Children from the low decile strata spent a greater proportion of time in the shop front setting than those from the medium and high decile strata. On average, children from schools in the high decile strata spent the greatest mean proportion of their time at public transport facilities than those from the low and medium decile stratum.
BMI category

Figure 18 displays the mean proportions of time children spent in each outdoor setting by BMI category. Children in the healthy (including underweight) BMI and overweight BMI categories spent similar proportions of their time in the street, outdoor recreation and sports settings. However, children in the healthy BMI category spent a greater proportion of their time at public transport facilities than children in the overweight or obese BMI categories. Notably, children in the obese BMI category spent a greater proportion of their time in the street setting, and considerably less time in the outdoor recreation and sports settings than children in the other two BMI categories. Further, children in the obese BMI category spent a greater proportion of their time in the shop front setting than children in the other BMI categories.
Summary

Overall, participants from all groups spent the majority of their outdoor time in the street setting. However, there were key differences in the proportion of time participants spent in each outdoor setting according to the different sociodemographic factors. Male participants spent a greater proportion of their time at public transport facilities than female participants. Female participants spent a greater proportion of their time in the outdoor recreation and sports settings than male participants. There were three notable differences by ethnic group. Māori participants spent a greater proportion of their time in the shop front setting than NZ European and Pacific participants. Pacific participants spent a greater proportion of time at fresh food markets than participants from the other two ethnic groups, and NZ European participants spent a greater proportion of their time at public transport facilities than Māori and Pacific participants. Children from schools in the low decile strata spent a greater proportion of their time...
time in the shop front setting than those from medium and high decile schools. Children from high decile schools spent a greater proportion of time at public transport facilities than those from low and medium decile schools.

**Median and mean and rates of exposure**

The calculated rates of exposure to outdoor food advertising are presented in the following two sections. The first section presents the median rates of non-core and core outdoor advertising to describe the variability in exposure rates among the study participants. The second section presents the mean rates of children’s outdoor advertising exposure as determined by Poisson regression methods. It also presents the incidence rate ratios (RR) comparing mean exposure rates between ethnic groups, school decile strata, BMI categories, and gender groups.

**Median rates of exposure to non-core and core outdoor food advertising**

The median hourly rates of non-core and core food advertising exposure were calculated for each child, individually and are presented as the number of advertising exposures per hour spent in outdoor settings. The proportions of participants with low (<1 advertising exposure/hour), moderate (≥1 and <5 exposures/hour), and high (≥5 exposures/hour) rate of exposure to non-core and core outdoor advertising are presented in Table 13. There was wide variation in the rates of exposure to non-core and core advertising among participants. As shown in Table 13, almost half of all participants had at least five exposures to non-core food advertisements per hour spent in outdoor settings. Comparatively, almost three-quarters of participants had less than one exposure to core food advertising per hour.
Table 13 Proportion of children with low, moderate and high rates of exposure to non-core and core outdoor food advertisements¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Proportion (%) of children with low &lt;1 exposure per hour</th>
<th>Proportion (%) of children with moderate ≥1 and &lt;5 exposures per hour</th>
<th>Proportion (%) of children ≥5 exposures per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-core</td>
<td>33.5</td>
<td>18.6</td>
<td>47.8</td>
</tr>
<tr>
<td>Core</td>
<td>74.0</td>
<td>22.6</td>
<td>3.4</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

Exposure to non-core and core advertising by ethnic group, school decile stratum, BMI and gender

Non-core

Table 14 presents the median rates of exposure to non-core food advertising in outdoor settings in proportions of children from each demographic group with low, moderate, and high non-core food advertising exposures per hour spent in outdoor settings (per hour).

There was wide variation in the individual rates of exposure among participants, and among the different demographic groups. Over three-quarters of NZ European children had moderate or high rates of exposure to non-core food advertising for every hour they spent in outdoor settings. Comparatively, just over 60% of both Māori and Pacific children had moderate or high exposure rates. The proportion of children with moderate or high exposure rates was highest in the high school decile strata. The proportion of children with moderate and high exposure rates was similar between children in the healthy and overweight BMI categories. However, almost 70% of children in the obese BMI category had ≥5 non-core food advertising exposures per hour. The median exposure rates were similar between gender groups.
**Table 14** Proportion of participants with low, moderate and high exposures to non-core advertising per hour spent in outdoor settings by ethnicity, school decile stratum, BMI, and gender¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Proportion with low exposure &lt;1 exposure per hour</th>
<th>Proportion with moderate exposure ≥1 and &lt;5 exposures per hour</th>
<th>Proportion with high exposure ≥5 exposures per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>33.5</td>
<td>18.6</td>
<td>47.8</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>23.6</td>
<td>24.6</td>
<td>51.8</td>
</tr>
<tr>
<td>Māori</td>
<td>37.4</td>
<td>11.2</td>
<td>51.4</td>
</tr>
<tr>
<td>Pacific</td>
<td>39.6</td>
<td>14.4</td>
<td>46.0</td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>41.2</td>
<td>17.3</td>
<td>41.5</td>
</tr>
<tr>
<td>Medium</td>
<td>32.5</td>
<td>13.1</td>
<td>54.5</td>
</tr>
<tr>
<td>High</td>
<td>22.8</td>
<td>25.7</td>
<td>51.5</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>28.2</td>
<td>22.2</td>
<td>49.6</td>
</tr>
<tr>
<td>Overweight</td>
<td>35.8</td>
<td>22.7</td>
<td>41.6</td>
</tr>
<tr>
<td>Obese</td>
<td>20.6</td>
<td>9.9</td>
<td>69.5</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>26.9</td>
<td>23.6</td>
<td>49.5</td>
</tr>
<tr>
<td>Male</td>
<td>30.7</td>
<td>17.6</td>
<td>51.7</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

**Core**

The rates of exposure to core advertising were low; almost three-quarters (74.0%) of participants had <1 exposure core food advertising per hour spent in outdoor settings. The proportion of Māori and Pacific children with low, moderate and high rates of core advertising exposure were similar. However, as shown in Table 15, only 1.1% of NZ European children had ≥5 exposures to core advertising per hour. The median rates of core advertising exposure were similar between children from low and medium school decile strata. However, the proportion of children with moderate rates of core exposure was highest in the high school decile strata. The proportion of children within each of the exposure rate categories was similar across BMI categories and gender groups.
Table 15 Proportion of participants with low, moderate and high exposures to core advertising per hour spent in outdoor settings by ethnicity, school decile stratum, and BMI¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Proportion with &lt;1 exposure per hour</th>
<th>Proportion with ≥1 and &lt;5 exposures per hour</th>
<th>Proportion with high exposure ≥5 exposures per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>74.0</td>
<td>22.6</td>
<td>3.4</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>72.2</td>
<td>26.7</td>
<td>1.1</td>
</tr>
<tr>
<td>Māori</td>
<td>77.3</td>
<td>15.5</td>
<td>7.2</td>
</tr>
<tr>
<td>Pacific</td>
<td>77.6</td>
<td>14.4</td>
<td>8.0</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>83.9</td>
<td>13.7</td>
<td>2.3</td>
</tr>
<tr>
<td>Medium</td>
<td>80.2</td>
<td>14.7</td>
<td>5.1</td>
</tr>
<tr>
<td>High</td>
<td>67.7</td>
<td>29.6</td>
<td>2.7</td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>79.9</td>
<td>18.0</td>
<td>2.2</td>
</tr>
<tr>
<td>Overweight</td>
<td>66.3</td>
<td>27.8</td>
<td>5.9</td>
</tr>
<tr>
<td>Obese</td>
<td>71.1</td>
<td>24.1</td>
<td>4.8</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>74.4</td>
<td>23.4</td>
<td>2.2</td>
</tr>
<tr>
<td>Male</td>
<td>73.6</td>
<td>21.9</td>
<td>4.5</td>
</tr>
</tbody>
</table>

¹Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.

Median rates of exposure to non-core and core food advertising by setting

Non-core

Table 16 displays the proportion of participants with low, moderate, and high hourly exposure rates to non-core advertising by outdoor setting. The highest rates of exposure to non-core food advertising occurred in the shop front and street settings. A small number of participants also captured non-core advertising in public transport facilities, sports settings, fresh food markets and outdoor recreation facilities. Only 11 children were exposed to non-core advertising in public transport facilities, and only six children were exposed to non-core food advertising in fresh food markets. Further, only one child was exposed to non-core food advertising in a service station forecourt. As the proportion of time spent in
the service station forecourt was very low across all participants, the results in this setting were excluded from all further analyses.

Table 16 Proportion of participants with low, moderate and high exposures to non-core advertising by outdoor setting¹

<table>
<thead>
<tr>
<th>Setting</th>
<th>Proportion with low exposure &lt;1 exposure per hour</th>
<th>Proportion with moderate exposure ≥1 and &lt;5 exposures per hour</th>
<th>Proportion with high exposure ≥5 exposures per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop front</td>
<td>37.8</td>
<td>28.9</td>
<td>33.3</td>
</tr>
<tr>
<td>Street</td>
<td>64.3</td>
<td>23.8</td>
<td>11.9</td>
</tr>
<tr>
<td>Fresh food market</td>
<td>96.3</td>
<td>1.0</td>
<td>2.7</td>
</tr>
<tr>
<td>Public transport facility</td>
<td>94.2</td>
<td>4.0</td>
<td>1.8</td>
</tr>
<tr>
<td>Sport</td>
<td>96.2</td>
<td>3.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Outdoor recreation</td>
<td>99.4</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Service station forecourt</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

Core

Exposure to core advertising was low in all outdoor settings, but highest in the shop front and street settings. As shown in Table 17, all participants had <1 exposure to core outdoor food advertising in the sports, outdoor recreation and service station forecourt settings. Only four children had core advertising exposures at public transport facilities. Further, only six children were exposed to core advertising at fresh food markets, and two children were exposed to core advertising in the sports setting. Only one child captured core advertising in the service station forecourt setting. Advertisements for all core foods were grouped into the ‘core’ category with no further breakdown of the type of core food advertised.
Table 17 Proportion of participants with low, moderate and high exposures to core advertising by outdoor setting¹

<table>
<thead>
<tr>
<th>Setting</th>
<th>Proportion with low exposure per hour</th>
<th>Proportion with moderate exposure ≥1 and &lt;5 exposures per hour</th>
<th>Proportion with high exposure ≥5 exposures per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop front</td>
<td>86.9</td>
<td>10.6</td>
<td>2.5</td>
</tr>
<tr>
<td>Street</td>
<td>95.8</td>
<td>4.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Fresh food market</td>
<td>96.2</td>
<td>3.3</td>
<td>0.5</td>
</tr>
<tr>
<td>Public Transport Facility</td>
<td>99.5</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Sport</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Outdoor recreation</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Service station forecourt</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

Median rates of advertising exposure by food product category

This section presents rates of exposure to non-core food advertisements by food product category. Table 18 displays the proportion of participants with low, moderate, and high rates of exposure to each non-core food product category. The exposure rates were highest for the fast food, sugary drinks, ice cream and cookies product categories. Six out of 10 children recorded at least one exposure to fast food in outdoor settings. Over half (54.9%) of the participants had moderate or high rates of exposure to fast food advertising per hour spent in outdoor settings. However, there was considerable variation in exposure rates among participants. One-third (32.6%) of participants had moderate or high levels of exposure to outdoor advertisements for sugary drinks. Moderate or high levels of exposure to ice cream advertising were recorded by a quarter (25.2%) of participants, while approximately one-fifth (19.8%) of participants recorded moderate or high levels of exposure to advertisements from the cookies product category. Over 90% of participants had <1 exposure per hour to outdoor advertisements for confectionery, snack food, diet drinks, unhealthy cereal and other non-core food products. The rates presented in Table 18 indicate that the data set is skewed, with the majority of participants having low rates of exposure to advertisements in each of the non-core product categories, with the exception of fast food.
Table 18 Proportion of participants with low, moderate and high exposures to non-core advertising by food product category\(^1\)

<table>
<thead>
<tr>
<th>Food product category</th>
<th>Proportion with low exposure &lt;1 exposure per hour</th>
<th>Proportion with moderate exposure ≥1 and &lt;5 exposures per hour</th>
<th>Proportion with high exposure ≥5 exposures per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast food</td>
<td>45.1</td>
<td>27.1</td>
<td>27.8</td>
</tr>
<tr>
<td>Sugary drinks</td>
<td>67.4</td>
<td>27.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Ice cream</td>
<td>74.8</td>
<td>19.1</td>
<td>6.1</td>
</tr>
<tr>
<td>Cookies</td>
<td>81.2</td>
<td>14.4</td>
<td>4.4</td>
</tr>
<tr>
<td>Confectionery</td>
<td>93.1</td>
<td>5.4</td>
<td>1.5</td>
</tr>
<tr>
<td>Snack foods</td>
<td>97.8</td>
<td>2.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Diet drinks</td>
<td>99.5</td>
<td>0.0</td>
<td>0.5</td>
</tr>
<tr>
<td>Unhealthy cereals</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other</td>
<td>99.6</td>
<td>0.4</td>
<td>0.0</td>
</tr>
</tbody>
</table>

\(^1\) Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

**Mean exposure rates to non-core and core outdoor food advertising**

The results of the Poisson regression analyses are presented in this section. The mean rates of non-core and core advertising exposure are presented alongside the incidence rate ratios (RR) comparing mean rates between ethnic groups, school decile strata, BMI categories and gender groups. Mean rates of non-core and core advertising exposure are also presented for each outdoor setting. For each outdoor setting, the mean rates of non-core exposure are also presented for each ethnic group, school decile stratum and BMI category as are the mean rates of non-core advertising exposure by product category. Results of the adjusted models of analysis are also presented, wherein rate ratios were calculated for each demographic group controlling for possible confounding by ethnicity and school decile stratum.

**Exposure to non-core outdoor food advertising**

Children in this study encountered a mean of 8.3 (95%CI 7.9 to 8.7) food advertisements (such as those shown in Figure 19) for every hour spent in
outdoor settings. Children were exposed to a mean of 7.4 (95%CI 7.0 to 7.8) non-core food advertisements per hour spent in outdoor settings. Comparatively, children were exposed to a mean of 0.8 (95%CI 0.7 to 1.0) core food advertisements for every hour spent in outdoor settings. Therefore, in outdoor settings, children in this study were exposed to non-core food advertising at a rate 7 times higher than that of core food advertising.

The results presented here are not directly comparable with the main findings from Kids’Cam, reported earlier in this chapter. This is because the results of the outdoor advertising analysis were calculated as rates of advertising exposure per hour spent in outdoor settings and the overall findings from Kids’Cam were calculated as rates of advertising exposure per 10 hour day. Overall, Kids’Cam participants were exposed to mean of 27.3 non-core and 12.3 core food instances of food marketing per day. The Kids'Cam results reported that children were exposed to non-core food advertising at a rate of 8.3 and 2.1 and core advertising at a rate of 0.9 and 0.4 advertisements per day in ‘other public spaces’ and ‘recreation venues’ respectively. Collectively, ‘other public spaces’ and ‘recreation venues’ include the following settings: street, shop front, shopping mall, private transport, public transport facility, on board public transport, other retail, and sport, outdoor recreation, and community venue settings. Many of these settings are outdoor settings that have been included in my analysis. Therefore, the Kids’Cam results suggest that outdoor advertising may account for approximately 30% of children’s overall daily exposure to non-core food marketing and approximately 10% of their daily exposure to core food marketing.
Rates of non-core outdoor advertising exposure by ethnicity, school stratum, BMI category, and gender

Participants’ exposure to non-core food advertising varied according to their ethnic group, school decile stratum, and assigned BMI category. The non-core exposure rates (95%CI) and rate ratios (95%CI) for each demographic factor are presented in Table 19. Within the table, the shaded rows denote statistically significant results (p<0.05). Comparing mean rates of exposure between ethnic groups revealed that Māori participants were 1.5 (95%CI 1.0 to 2.2) times as likely to be exposed to non-core outdoor food advertising as NZ European participants. As shown in Table 19, exposure rates were similar between NZ European and Pacific groups. When comparing mean rates between school decile strata, no statistically significant differences were found. However, children from schools in the medium decile stratum had the highest mean rate of non-core advertising exposure.
By comparison, there were statistically significant differences in non-core exposure rates by children’s BMI category. Although exposure rates were similar between participants in the healthy and overweight categories, comparing rates between children from those in the healthy with those from the obese category gave a rate ratio of 1.7 (95%CI 1.2 to 2.4). Children in the obese category were exposed to a mean of 10.8 (95%CI 7.3 to 15.9) non-core advertisements per hour compared to a mean rate of 6.5 (95%CI 5.5 to 7.8) advertisements per hour calculated for participants in the healthy weight category. There were no statistically significant differences in rates of exposure to non-core advertising by gender.

Table 19 Mean rates of exposure from Poisson regression models to non-core advertising per hour spent in outdoor settings by ethnic group, school decile stratum, BMI category, and gender with rate ratios (with 95% confidence intervals) comparing rates within demographic groups¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Mean rate of exposure per hour (95% CI)</th>
<th>Rate ratio between groups (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>6.3 (5.1-7.8)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>9.3 (6.8-12.9)</td>
<td>1.5 (1.0 – 2.2)</td>
<td>0.046</td>
</tr>
<tr>
<td>Pacific</td>
<td>6.9 (4.1-11.4)</td>
<td>1.1 (0.6 – 1.9)</td>
<td>0.748</td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>7.4 (5.2-10.5)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>8.4 (6.6-10.7)</td>
<td>1.1 (0.74 -1.7)</td>
<td>0.543</td>
</tr>
<tr>
<td>High</td>
<td>6.2 (4.6-8.2)</td>
<td>0.8 (0.5 -1.3)</td>
<td>0.423</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>6.5 (5.5-7.8)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>6.1 (3.4-11.1)</td>
<td>0.9 (0.5-1.8)</td>
<td>0.827</td>
</tr>
<tr>
<td>Obese</td>
<td>10.8 (7.3-15.9)</td>
<td>1.7 (1.2-2.4)</td>
<td>0.008</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>7.6 (7.1-8.1)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>7.2 (6.7- 7.8)</td>
<td>0.95 (0.9-1.1)</td>
<td>0.325</td>
</tr>
</tbody>
</table>

¹Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.

*Shaded rows denote statistically significant results (p<0.05)
Adjusted rate ratios comparing exposures to non-core advertising by ethnicity and school decile stratum

Table 20 displays the results of the adjusted analysis model. As shown in

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Rate ratio between groups (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>1.5 (0.9-2.3)</td>
<td>0.101</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.1 (0.6-1.9)</td>
<td>0.782</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>1.3 (0.8-1.9)</td>
<td>0.254</td>
</tr>
<tr>
<td>High</td>
<td>1.0 (0.6-1.5)</td>
<td>0.859</td>
</tr>
</tbody>
</table>

Table 20, the RRs did not change substantially within each of the demographic groups. However, after controlling for school decile strata, the 95% confidence intervals for the Māori RR widened to include the null value. However, these results suggest that Māori participants may have up to 50% greater exposure to non-core food advertising in outdoor settings than NZ European participants.

Table 20 Rate ratios (with 95% confidence intervals) from Poisson regression models for non-core exposure rates accounting for school decile stratum (model 1) and ethnicity (model two)

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Rate ratio between groups (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>1.5 (0.9-2.3)</td>
<td>0.101</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.1 (0.6-1.9)</td>
<td>0.782</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>1.3 (0.8-1.9)</td>
<td>0.254</td>
</tr>
<tr>
<td>High</td>
<td>1.0 (0.6-1.5)</td>
<td>0.859</td>
</tr>
</tbody>
</table>

¹Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children
Exposure to outdoor core food advertising

Rate of core exposures by ethnic group, school stratum, BMI category and gender
Table 21 displays the mean rates of exposure to core food advertising by ethnic group, school decile strata and BMI category. Differences in mean exposure rates to core food advertising (example shown in Figure 20) were observed by ethnic group and BMI category, but not school decile stratum.

As shown in
Table 21, the mean rate of core food advertising exposure was 70% higher for Māori than NZ European participants. Participants who were classified as healthy or overweight had similar mean rates of exposure to core food advertising per hour spent in outdoor settings. Comparatively, children in the obese category were 2.5 (95%CI 1.1 to 5.6) times as likely as children from the healthy weight category to be exposed to core food advertising. Differences in the mean rates of exposure to core advertising were also observed by gender. Male participants had significantly higher mean rates of exposure (RR 1.4, 95%CI 1.0 to 1.9) to core advertising in outdoor settings than female participants.

Figure 20 Example of outdoor core food advertising
Table 21 Mean rates (with 95% confidence intervals) of exposure from Poisson regression models for core advertising per hour spent in outdoor settings by ethnic group, school decile stratum, BMI category, and gender with rate ratios (with 95% confidence intervals) comparing rates within demographic groups¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Mean rate of exposure per hour (95% CI)</th>
<th>Rate ratio between groups (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>0.6 (0.5-0.8)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>1.1 (0.8-1.5)</td>
<td>1.7 (1.2-2.5)</td>
<td>0.009</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.9 (0.3-2.9)</td>
<td>1.4 (0.4-4.6)</td>
<td>0.601</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.8 (0.4-1.4)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>0.9 (0.6-1.3)</td>
<td>1.1 (0.5-2.3)</td>
<td>0.792</td>
</tr>
<tr>
<td>High</td>
<td>0.7 (0.5-0.9)</td>
<td>0.9 (0.5-1.7)</td>
<td>0.696</td>
</tr>
<tr>
<td>BMI Category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>0.7 (0.4-1.2)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>0.6 (0.4-1.2)</td>
<td>1.0 (0.5-1.8)</td>
<td>0.885</td>
</tr>
<tr>
<td>Obese</td>
<td>1.7 (0.7-3.7)</td>
<td>2.5 (1.1-5.6)</td>
<td>0.035</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.7 (0.6-0.9)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.0 (0.8-1.2)</td>
<td>1.4 (1.0-1.9)</td>
<td>0.023</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.

*Shaded rows denote statistically significant results (p<0.05)

**Adjusted rate ratios comparing exposures to core advertising by ethnicity and school decile stratum**

The adjusted rate ratios for each demographic factor are presented in Table 22. In the adjusted model, the rate ratio of core advertising exposure among Māori participants remained higher, at a rate 1.8 (95%CI 1.2 to 2.8) times the mean rate of core exposure for NZ European participants. As shown in Table 22, the difference in the mean rates of exposure among NZ European and Pacific children were not statistically significant. However, the results indicate that Pacific children may have higher mean rates of core exposure than NZ European children after controlling for school decile stratum. After adjusting for ethnic group, differences between school decile strata became more pronounced indicating that rates of core exposure may be higher among participants from medium and high decile schools. However, these results were not statistically significant.
Table 22 Rate ratios (with 95% confidence intervals) from Poisson regression models for core exposure rates accounting for school decile stratum (model 1) and ethnicity (model two)¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Rate ratio between groups (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>1.8 (1.2-2.8)</td>
<td>0.011</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.5 (0.3-6.9)</td>
<td>0.603</td>
</tr>
<tr>
<td>School stratum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>1.4 (0.6-3.2)</td>
<td>0.405</td>
</tr>
<tr>
<td>High</td>
<td>1.2 (0.4-3.3)</td>
<td>0.714</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

*Shaded rows denote statistically significant results (p<0.05)

Non-core and core advertising exposures by setting

The mean rates of exposure to non-core and core advertising by setting are presented in Table 23. Children’s exposures to non-core and core advertising were concentrated around shop fronts and in the street setting.

Non-core

In the shop front setting, the mean rate of exposure to non-core food advertising was 4.7 (95%CI 4.4 to 5.0) per hour spent in outdoor settings. My knowledge of the image data (through my experience of coding the data) suggests that the outdoor food advertising captured on shop fronts was largely at convenience stores and fast food outlets. In the street, the mean rate of exposure to non-core food advertisements was 1.7 (95%CI 1.5 to 1.9) per hour. As displayed in Table 23, exposure to non-core advertising also occurred in outdoor recreation and sports settings as well as at fresh food markets. However, the definition of sports setting used in this thesis included swimming pools, indoor and outdoor sports stadiums and sports clubrooms as well as sports grounds. As such, the mean rate of exposure to non-core and core advertising in sports settings could be an overestimate as it may include advertising captured in indoor settings. Exposure
to non-core advertising was very low at public transport facilities and in the service station forecourt setting.

Core

As shown in Table 23, the mean rates of core exposure in the street and shop front settings were much lower than for non-core advertising, 0.2 (95%CI 0.1 to 0.3) exposures per hour and 0.4 (95%CI 0.4 to 0.5), respectively. The mean rate of exposure to core food advertising was zero per hour for the outdoor recreation, sport, public transport facility and service station settings. These results do not necessarily suggest a lack of advertising in such settings, but possibly that children spent very little time in these settings while wearing the cameras. The service station forecourt setting excluded the service station store, which was coded as a convenience store and was therefore excluded from the outdoor analysis. Due to the small number of exposures, the results from the sport, outdoor recreation, public transport facility and service station forecourt settings will not be presented in further analyses but are attached in Appendix 10.

Table 23 Mean rates (with 95% confidence intervals) of exposure from Poisson regression for core and non-core advertising by outdoor setting per hour spent outdoors

<table>
<thead>
<tr>
<th>Setting</th>
<th>Mean rate non-core exposure per hour spent outdoors (95% CI)</th>
<th>Mean rate core exposure per hour spent outdoors (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop front</td>
<td>4.7 (4.4- 5.0)</td>
<td>0.4 (0.4-0.5)</td>
</tr>
<tr>
<td>Street</td>
<td>1.7 (1.5-1.9)</td>
<td>0.2 (0.1-0.3)</td>
</tr>
<tr>
<td>Fresh food market</td>
<td>0.4 (0.3-0.5)</td>
<td>0.2 (0.1-0.2)</td>
</tr>
<tr>
<td>Sport</td>
<td>0.3 (0.2-0.4)</td>
<td>0.0 (0.0-0.0)</td>
</tr>
<tr>
<td>Outdoor recreation</td>
<td>0.2 (0.1-0.3)</td>
<td>0.0 *</td>
</tr>
<tr>
<td>Public transport facility</td>
<td>0.1 (0.1-0.2)</td>
<td>0.0 (0.0-0.0)</td>
</tr>
<tr>
<td>Service station</td>
<td>0.0 (0.0-0.0)</td>
<td>0.0 (0.0-0.0)</td>
</tr>
</tbody>
</table>

¹Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.

Rates of non-core advertising exposures by setting and demographic variables

The mean exposure rates (95%CI) to non-core advertising in three outdoor settings by ethnicity, school decile strata, BMI category and gender are presented in Table 24 together with the rate ratios comparing rates of exposure between these groups. As exposure rates to core and non-core food advertising in sports
and outdoor recreation settings, public transport facilities, and service station forecourts were low, only the mean rates of exposure in the shop front, street and fresh food market settings will be reported in this section. However, mean exposure rates to non-core and core advertising and rate ratios comparing rates by demographic factors were calculated for all other settings and are attached as supplementary tables in Appendix 11. An example of non-core food advertising (Powerade and Hot Dogs) at a fresh food market is shown in Figure 21.

**Ethnicity**

The mean rate of exposure to non-core advertising was highest for all groups in the shop front setting. Māori and Pacific participants had greater mean rates of exposure to non-core food advertising in the shop front and fresh food market settings than NZ European participants. This difference was particularly pronounced in the fresh food market setting Pacific children were 9.4 (95%CI 0.5 to 168.5) times as likely to encounter non-core food advertising as NZ European participants. However, these differences were not statistically significant and the wide 95%CIs suggest that the study was under-powered to examine ethnic differences in exposure by setting.

**School decile stratum**

In the shop front setting, the mean rates of exposure to non-core advertising did not show significant variation by school decile stratum. However, in the street setting statistically significant differences were observed in non-core exposure rates between participants from low and medium, but not high school decile strata. On average, participants from schools in the medium decile strata had 2.5 (95%CI 1.4 to 4.6) greater exposure to non-core food advertising than participants from low decile schools. Statistically significant differences were found in non-core advertising exposure at fresh food markets by school decile stratum. Participants from medium decile schools had significantly lower rates of exposure than participants from low decile schools in this setting. However, it is likely that this is explained by differences in time spent in that setting.
BMI
Rates of non-core exposure in the different settings showed some variation by participant BMI. As shown in Table 24, in the shop front setting the rate of non-core exposure was similar between healthy and overweight participants. However, children categorised as obese had twice (RR 2.0, 95%CI 1.2 to 3.3) the rate of exposure to non-core advertising than children in the healthy weight category. Mean rates of non-core exposure were similar among all BMI groups in the street setting. In the fresh food market setting, participants from the overweight and obese categories had exposure rates 2.3 (95%CI 0.2 to 23.1) and 5.5 (95%CI 0.3 to 93.0) times greater exposure rates to non-core food advertising, respectively, than those in the healthy BMI category. However, these differences were not statistically significant.

Gender
There was little variation in exposure rates by gender in the street and shop front settings. Although the mean rate of exposure to non-core advertising at fresh food markets was 3.0 (95%CI 0.6 to 16.4) times higher for male than female participants, this result was not statistically significant.
Figure 21 Example of non-core outdoor food advertising at a fresh food market

*Adjusted rate ratios comparing rates of non-core exposure in outdoor settings by ethnicity and school decile stratum*

The results of the adjusted model of analysis are presented in Table 25. The results from the fresh food market setting are not presented as there were not enough exposures in the data set to perform the analysis in this setting. After controlling for school decile stratum, no statistically significant differences were observed between NZ European and Māori, and NZ European and Pacific participants in the street and shop front settings. The adjusted rate ratios comparing exposures in the shop front and street settings by school decile strata changed little from the unadjusted rate ratios. However, children from the medium school decile stratum had 2.3 (95%CI 1.2 to 4.6) times the rate of exposure to non-core advertising in the street setting than children from the low school decile strata.
<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Street</th>
<th>Shop front</th>
<th>Fresh food market</th>
<th>p-value</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95% CI)</td>
<td>p-value</td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95% CI)</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>1.9 (1.1-3.1)</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>2.0 (1.4-2.8)</td>
<td>1.0 (0.6-1.9)</td>
<td>0.880</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacific</td>
<td>1.0 (0.3-3.0)</td>
<td>0.5 (0.2-1.8)</td>
<td>0.279</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0 (0.6-0.7)</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>2.5 (1.9-3.3)</td>
<td>2.5 (1.4-4.6)</td>
<td>0.004</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1.7 (0.9-3.3)</td>
<td>1.8 (0.8-4.1)</td>
<td>0.167</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>1.9 (1.2-2.8)</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>1.3 (0.6-2.9)</td>
<td>0.7 (0.4-1.2)</td>
<td>0.172</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>2.0 (1.1-3.7)</td>
<td>1.1 (0.5-2.5)</td>
<td>0.824</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.8 (1.2-2.8)</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.7 (1.0-3.1)</td>
<td>1.0 (0.6-1.6)</td>
<td>0.867</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.

*Shaded rows denote statistically significant results (p<0.05)
Table 25 Rate ratios (with 95% confidence intervals) from Poisson regression models for non-core exposure rates by setting accounting for school decile stratum (model 1) and ethnicity (model two)¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Street</th>
<th></th>
<th></th>
<th></th>
<th>Shop front</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate ratio (95%CI)</td>
<td>p-value</td>
<td>Rate ratio (95%CI)</td>
<td>p-value</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>1.0</td>
<td></td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>1.1 (0.7-1.9)</td>
<td>0.553</td>
<td>1.3 (0.7-2.3)</td>
<td>0.399</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pacific</td>
<td>0.6 (0.2-1.9)</td>
<td>0.401</td>
<td>1.0 (0.6-1.7)</td>
<td>0.936</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>2.3 (1.2-4.6)</td>
<td>0.018</td>
<td>1.1 (0.7-1.7)</td>
<td>0.773</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1.6 (0.8-3.1)</td>
<td>0.146</td>
<td>0.7 (0.4-1.2)</td>
<td>0.183</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

*Shaded rows denote statistically significant results (p<0.05)

Rates of core advertising exposures by settings and demographic variables

The mean rates (95% CI) of exposure to core advertising by setting, ethnic group, school decile stratum, BMI category, and gender are presented in Table 26 alongside rate ratios comparing rates of exposure between demographic groups. As shown in Table 26, there were no statistically significant differences in the mean rates of core advertising exposure by ethnicity or school decile stratum. However, Māori participants had greater rates of core food advertising exposure in the shop front and fresh food market settings than NZ European participants. Notably, Pacific participants also had 5.5 (95%CI 0.2 to 147.7) times greater exposure to core food advertising in the fresh food market setting than NZ Europeans. However, as discussed above, the wide 95% CIs indicate that the study was under-powered to examine ethnic differences in exposure by setting. There were few differences in mean rates of core advertising exposures by BMI category. However, in the shop front setting, children in the obese category were exposed to core food advertising at a rate 2.8 (95%CI 1.6 to 5.2) times higher than those in the healthy BMI category. Further, in the fresh food market setting, obese participants had greater core exposure rates than their healthy weight peers. There were no differences in the street or shop front setting by gender. However, in the fresh food market setting, male participants had 4.7 (95%CI 1.2 to 18.7)
times the rate observed among female participants. The adjusted model could not be run using the core rates of exposure due to the low number of core exposures in the data set.
Table 26 Mean rates (with 95% confidence intervals) of exposure from Poisson regression to core advertising by outdoor setting with rate ratios (95% CIs) comparing rates within demographic groups¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Street</th>
<th>Shop front</th>
<th>Fresh food market</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95%CI)</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>0.2 (0.1-0.4)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>0.2 (0.1-0.3)</td>
<td>0.9 (0.4-1.9)</td>
<td>0.747</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.1 (0.0-0.6)</td>
<td>0.6 (0.1-3.6)</td>
<td>0.590</td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.1 (0.0-0.2)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>0.3 (0.1-0.7)</td>
<td>3.9 (0.8-18.7)</td>
<td>0.088</td>
</tr>
<tr>
<td>High</td>
<td>0.2 (0.1-0.4)</td>
<td>2.9 (0.7-12.3)</td>
<td>0.134</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>0.2 (0.1-0.4)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>0.2 (0.0-0.6)</td>
<td>0.8 (0.3-2.2)</td>
<td>0.620</td>
</tr>
<tr>
<td>Obese</td>
<td>0.2 (0.1-0.6)</td>
<td>0.9 (0.3-3.3)</td>
<td>0.890</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.2 (0.1-0.4)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.1 (0.0-0.5)</td>
<td>0.6 (0.2-2.4)</td>
<td>0.491</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

*Shaded rows denote statistically significant results (p<0.05)
Non-core advertising exposure rates by product category

The results presented in Table 27 indicate that children in this study were primarily exposed to advertising for fast food, sugary drinks, ice cream, cookies, cakes, and pastries, and confectionery in outdoor settings. The mean rate of exposure to non-core food advertising was highest for the fast food, sugary drinks and ice cream categories. Cookies, and to a lesser extent confectionery, also appear to be important sources of exposure to non-core food advertising in outdoor settings.

The results also suggest that the children in the study were not significantly exposed to advertising for snack foods, unhealthy cereals and unhealthy milk products in outdoor settings. One of the most interesting findings is the lack of advertising for diet drinks. The mean rate of exposure to diet drinks advertising was zero per hour; only three children captured instances of advertising for diet drinks in outdoor settings. Comparatively, 68 instances of outdoor advertisements for sugary drinks and juices were captured by children in this study. Due to the low number of captured instances of food advertising for the above product categories, further analyses are only presented for those product categories shaded in Table 27.

Table 27 Mean rate (with 95% confidence intervals) of exposure from Poisson regression to non-core advertising by product category

<table>
<thead>
<tr>
<th>Product category</th>
<th>Mean rate (95%CI) non-core advertising exposure per hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast food</td>
<td>4.0 (3.8-4.3)</td>
</tr>
<tr>
<td>Sugary drinks</td>
<td>1.2 (1.1-1.4)</td>
</tr>
<tr>
<td>Ice cream</td>
<td>1.1 (0.9-1.2)</td>
</tr>
<tr>
<td>Cookies, cakes, and pastries</td>
<td>0.7 (0.6-0.9)</td>
</tr>
<tr>
<td>Confectionery</td>
<td>0.2 (0.2-0.3)</td>
</tr>
<tr>
<td>Snack foods</td>
<td>0.0 (0.0-0.1)</td>
</tr>
<tr>
<td>Unhealthy cereals</td>
<td>0.0 (0.0-0.0)</td>
</tr>
<tr>
<td>Diet drinks</td>
<td>0.0 (0.0-0.0)</td>
</tr>
<tr>
<td>Unhealthy milk products</td>
<td>0.0 (0.0-0.0)</td>
</tr>
<tr>
<td>Other</td>
<td>0.0 (0.0-0.1)</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.
Mean non-core exposure rates by product category and demographic variables

**Ethnicity**

Few ethnic differences were observed in exposure rates to non-core advertising by product category. However, the results presented in Table 28 indicate that the mean rate of exposure to fast food advertising (example shown in Figure 22) among Māori participants was 1.9 (95%CI 1.1 to 3.3) times higher than the mean rate for NZ European participants. Mean exposure rates to advertising for sugary drinks, ice cream, cookies, cakes and pastries, confectionery and snack foods do not appear to be patterned by ethnicity, as there were no statistically significant differences in mean rates of exposure between ethnic groups.

**School decile stratum**

There were few differences in the rate of exposure to advertising for each product category by school decile stratum. The rates of exposure to fast food, sugary drinks, cookies, confectionery and snack foods were similar across all school decile strata. However, statistically significant differences were observed in the mean exposure rates to ice cream advertisements between those in the low and medium school decile strata. Participants in the medium school strata had 2.3 (95%CI 1.5 to 4.3) times the exposure to ice cream advertising than participants from the low school decile stratum.

**BMI**

The results displayed in Table 28 and Table 29 show the mean rates of exposure to food advertisements per hour by food product and participant BMI category. The mean rates of exposure to fast food and sugary drink advertising were patterned by BMI category. Children from the overweight category had a lower mean rate (RR 0.6, 95%CI 0.4 to 1.0) of exposure to fast food advertising than those categorised as healthy. Children from the obese category had 2.2 (95%CI 1.0 to 4.6) times the rate of exposure to sugary drink advertising than those in the healthy BMI category. Although not a statistically significant finding, participants
in the obese category had a higher mean rate of exposure to advertisements for confectionery than those in the healthy category, indicating that those in the obese BMI category may have had a greater likelihood of being exposed to advertising for confectionery products than their healthy weight peers.

**Gender**

There were few differences in exposure to the non-core products by gender group. However as shown in Table 29, the mean rate of exposure to confectionery advertising was lower for male than female participants.

**Summary**

Overall, these findings suggest that Māori children were exposed to greater rates of fast food advertising than NZE children. Children from the medium decile strata had significantly higher rates of exposure to ice cream advertising than those in low decile strata. Otherwise, results did not appear to be patterned by school decile stratum. There was some patterning of exposure rates by BMI with obese children having higher mean rates of exposure to advertising for sugary drinks than healthy weight children. Interestingly, children in the overweight category had lower rates of exposure to fast food advertising than those from the healthy BMI category.
Adjusted rate ratios of non-core food advertising exposure for each food product category by ethnicity and school decile stratum

In the adjusted model, rate ratios did not differ considerably from those in the unadjusted analyses. As displayed in Table 30, Māori participants were exposed to outdoor fast food advertising at twice the rate of New Zealand European participants. There were no other statistically significant differences between ethnic groups across the food product categories in this analysis. However, the rate ratios may indicate that, controlling for school decile strata, Māori and Pacific children in this sample may have greater rates of exposure to confectionery advertising than NZ European children. Although there were no statistically significant differences in mean rates of exposure to fast food, sugary drinks, cookies, cakes, and pastries, or ice cream advertising by school decile stratum, the results suggest that participants from medium decile schools had greater exposure to outdoor ice cream advertising than those from low decile schools. Further, children from high decile schools in this study may have had greater exposure to outdoor confectionery advertising than those from low decile schools.
Table 28 Mean rates (with 95% confidence intervals) of exposure and rate ratios (with 95% confidence intervals) from Poisson regression to non-core outdoor food advertising by product category, ethnicity, school decile stratum, BMI category and gender

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Fast food</th>
<th></th>
<th></th>
<th>Sugary drinks</th>
<th></th>
<th></th>
<th>Ice cream</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95% CI)</td>
<td>p-value</td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95% CI)</td>
<td>p-value</td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95% CI)</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>3.0 (2.1-4.3)</td>
<td>1.0</td>
<td></td>
<td>1.1 (0.8-1.5)</td>
<td>1.0</td>
<td></td>
<td>1.1 (0.7-1.9)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>5.7 (3.8-8.6)</td>
<td>1.9 (1.1-3.3)</td>
<td>0.02</td>
<td>1.4 (1.0-2.0)</td>
<td>1.3 (0.8-2.0)</td>
<td>0.281</td>
<td>0.9 (0.6-1.3)</td>
<td>0.8 (0.4-1.4)</td>
<td>0.377</td>
</tr>
<tr>
<td>Pacific</td>
<td>3.9 (2.2-6.9)</td>
<td>1.3 (0.7-2.5)</td>
<td>0.442</td>
<td>1.0 (0.6-1.6)</td>
<td>0.9 (0.5-1.5)</td>
<td>0.646</td>
<td>0.9 (0.3-2.2)</td>
<td>0.8 (0.3-2.2)</td>
<td>0.599</td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>4.1 (2.8-6.1)</td>
<td>1.0</td>
<td></td>
<td>1.3 (0.7-2.2)</td>
<td>1.0</td>
<td></td>
<td>0.8 (0.5-1.5)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>4.2 (3.5-5.1)</td>
<td>1.0 (0.7-1.6)</td>
<td>0.895</td>
<td>1.1 (0.5-2.6)</td>
<td>0.9 (0.3-2.4)</td>
<td>0.814</td>
<td>1.9 (1.5-2.4)</td>
<td>2.3 (1.2-4.3)</td>
<td>0.017</td>
</tr>
<tr>
<td>High</td>
<td>3.1 (2.0-4.9)</td>
<td>0.8 (0.4-1.4)</td>
<td>0.344</td>
<td>1.1 (0.9-1.4)</td>
<td>0.9 (0.5-1.6)</td>
<td>0.637</td>
<td>0.9 (0.3-2.2)</td>
<td>1.1 (0.3-3.2)</td>
<td>0.927</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>3.7 (2.8-4.8)</td>
<td>1.0</td>
<td></td>
<td>0.9 (0.6-1.6)</td>
<td>1.0</td>
<td></td>
<td>1.0 (0.7-1.3)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>2.2 (1.2-4.0)</td>
<td>0.6 (0.4-1.0)</td>
<td>0.037</td>
<td>1.6 (0.6-4.2)</td>
<td>1.7 (0.4-6.8)</td>
<td>0.443</td>
<td>1.2 (0.4-3.9)</td>
<td>1.3 (0.5-3.4)</td>
<td>0.628</td>
</tr>
<tr>
<td>Obese</td>
<td>5.6 (3.1-10.0)</td>
<td>1.5 (0.9-2.6)</td>
<td>0.113</td>
<td>2.2 (1.2-3.5)</td>
<td>2.2 (1.0-4.6)</td>
<td>0.047</td>
<td>1.6 (0.7-3.7)</td>
<td>1.6 (0.7-4.1)</td>
<td>0.278</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>3.7 (2.5-5.5)</td>
<td>1.0</td>
<td></td>
<td>0.9 (0.6-1.5)</td>
<td>1.0</td>
<td></td>
<td>0.9 (0.5-1.5)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>3.2 (2.3-4.3)</td>
<td>0.8 (0.6-1.2)</td>
<td>0.335</td>
<td>1.4 (0.7-2.8)</td>
<td>1.5 (0.5-4.3)</td>
<td>0.415</td>
<td>1.3 (0.6-2.9)</td>
<td>1.5 (0.7-3.2)</td>
<td>0.255</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.

*Shaded rows denote statistically significant results.
### Table 29 Mean rates (with 95% confidence intervals) of exposure and rate ratios (with 95% confidence intervals) from Poisson regression to non-core outdoor food advertising by product category, ethnicity, school decile stratum, BMI category and gender¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Cookies</th>
<th>Confectionery</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95%CI)</td>
<td>Rate ratio (95%CI)</td>
<td>p-value</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>0.6 (0.3-1.1)</td>
<td>1.0</td>
<td>0.2 (0.1-1.0)</td>
</tr>
<tr>
<td>Māori</td>
<td>0.8 (0.4-1.6)</td>
<td>1.4 (0.6-3.4)</td>
<td>0.426</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.6 (0.2-1.7)</td>
<td>1.2 (0.3-3.5)</td>
<td>0.922</td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.7 (0.3-1.7)</td>
<td>1.0</td>
<td>0.2 (0.1-0.5)</td>
</tr>
<tr>
<td>Medium</td>
<td>0.8 (0.5-1.3)</td>
<td>1.2 (0.4-3.1)</td>
<td>0.735</td>
</tr>
<tr>
<td>High</td>
<td>0.6 (0.2-1.3)</td>
<td>0.8 (0.2-2.6)</td>
<td>0.475</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>0.6 (0.4-0.8)</td>
<td>1.0</td>
<td>0.2 (0.1-0.9)</td>
</tr>
<tr>
<td>Overweight</td>
<td>0.6 (0.2-2.2)</td>
<td>1.1 (0.4-3.2)</td>
<td>0.852</td>
</tr>
<tr>
<td>Obese</td>
<td>0.8 (0.4-1.5)</td>
<td>1.3 (0.6-3.0)</td>
<td>0.535</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.6 (0.4-1.0)</td>
<td>1.0</td>
<td>0.4 (0.1-1.0)</td>
</tr>
<tr>
<td>Male</td>
<td>0.6 (0.3-1.6)</td>
<td>1.0 (0.5-2.1)</td>
<td>0.902</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children
Table 30 Rate ratios (with 95% confidence intervals) from Poisson regression models for non-core exposure rates by food product category accounting for school decile stratum (model 1) and ethnicity (model two) ¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Fast food</th>
<th>Sugary drinks</th>
<th>Ice cream</th>
<th>Cookies</th>
<th>Confectionery</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate ratio (95% CI)</td>
<td>p-value</td>
<td>Rate ratio (95% CI)</td>
<td>p-value</td>
<td>Rate ratio (95% CI)</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Māori</td>
<td>1.9 (1.0-3.5)</td>
<td>0.040</td>
<td>1.2 (0.7-2.0)</td>
<td>0.406</td>
<td>0.7 (0.4-1.2)</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.3 (0.7-2.5)</td>
<td>0.409</td>
<td>0.8 (0.4-1.5)</td>
<td>0.530</td>
<td>0.7 (0.3-1.8)</td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Medium</td>
<td>1.3 (0.8-2.1)</td>
<td>0.295</td>
<td>0.9 (0.4-2.1)</td>
<td>0.774</td>
<td>1.9 (1.0-3.8)</td>
</tr>
<tr>
<td>High</td>
<td>1.0 (0.5-1.8)</td>
<td>0.991</td>
<td>0.9 (0.5-1.6)</td>
<td>0.646</td>
<td>0.9 (0.4-2.0)</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children
*Shaded rows denote statistically significant results (p<0.05)
Chapter summary

Overall children in this study collected a median of 44.2 minutes of image data in outdoor settings across the four-day data collection period. Children spent the greatest proportion of their outdoor time in the street, outdoor recreation, sport and shop front settings.

The results presented in this chapter suggest that there was large individual variation in non-core and core outdoor food advertising exposures. Overall, children were exposed to a mean of 8.3 (95%CI 7.9 to 8.7) food advertisements per hour spent in outdoor settings. In all, 7.4 (95%CI 7.0 to 7.8) of these advertising encounters were for non-core food products compared to 0.8 (95%CI 0.7 to 1.0) per hour for core food products. This finding suggests that in outdoor settings children are exposed to non-core food advertising at 7 times the rate of core food advertising.

On average, Māori participants had greater mean rates of non-core advertising exposure than NZ European participants. Māori participants had a mean of 9.3 (95%CI 6.8 to 12.9) non-core food advertisement per hour, and NZ European participants had a mean of 6.3 (95%CI 5.1 to 7.8). Although there were no significant differences in non-core exposure rates observed between school decile strata, differences were observed by BMI category. Participants in the obese category were exposed to non-core food advertising at a mean rate of 10.8 (95%CI 7.3 to 15.9) exposures per hour, a rate 70% higher than the mean rate among those from the healthy BMI category.

Exposure to core advertising also followed a similar pattern with Māori participants and those from the obese category having higher core exposure rates than NZ European and healthy weight participants respectively. Māori children were exposed to a mean of 1.1 (95%CI 0.8 to 1.5) core advertisements per hour, while NZ European children encountered an average of 0.6 (95%CI 0.5 to 0.8) core advertisements per hour. Children from the obese category were 2.5 (95%CI 1.1 to 5.6) as likely to be exposed to core food advertising than those from the healthy category. Overall, children from the obese category encountered a mean of 1.7
(95%CI 0.7 to 3.7) core advertisements per hour while those from the healthy group encountered a mean of 0.7 (95%CI 0.4 to 1.2).

Overall, the majority of non-core and core advertising exposures occurred at shop fronts, on the street, and at fresh food markets. The results presented in this chapter suggest that Māori children and children in the obese category may be exposed to (and therefore encounter) outdoor non-core and core food advertising at higher rates than their NZ European and healthy weight peers.

Children in this study were primarily exposed to outdoor advertisements for non-core food products, specifically, fast food, sugary drinks, ice cream, cookies, cakes and pastries, and confectionery. Notably, advertisements for diet drinks, snack foods and high sugar, low fibre breakfast cereals were seldom captured in this study. Further, Māori children were exposed to fast food advertising at almost double the rate of NZ European children. Differences were also found between participants in the different BMI categories. Obese children encountered twice as many advertisements for sugary drinks per hour than those in the healthy weight category. Interestingly, children from the overweight category encountered 40% less fast food advertising per hour than children from the healthy weight category.

The following chapter, Chapter Seven, reports on the results of the analyses to determine children's exposure to non-core and core outdoor advertising on the journey to and from school.
Chapter Seven: Results children’s exposure to outdoor advertising on the journey to or from school

Introduction

This chapter presents the results of the analyses to determine the extent and nature of children’s exposure to outdoor food advertising on the journey to or from school. The analysis includes image data collected from the time each child left their house in the morning until the first image captured in the school setting, and between the first non-school image and the first image captured in the home setting in the afternoon. This dataset included images from Thursdays and Fridays only. As in the previous chapter, this chapter is divided into six sections. The first describes the demographic characteristics of the study participants. The second describes the number of journeys recorded by the participants, how much data they collected, and where they spent their time during the journeys. Participants’ median outdoor advertising exposures rates, per journey, are then reported to describe individual variation in the number and types of exposures captured. Fourth, the mean rates of exposure to non-core and core advertising per journey are presented by key sociodemographic features. The mean exposure rates for each setting in which outdoor advertising exposures occurred are then presented. Finally, the mean rates of outdoor advertising exposure by non-core food product type are given.

Demographic characteristics of the study sample

Of the 168 Kids’Cam participants, 39 participants were excluded from the analysis as they did not collect any outdoor data on their journey to or from school on Thursday or Friday. Participants were included in the sample if they had journey data for at least one of the four possible journeys, that is, two journeys to school and/or two from school. In total, the sample included data from 129 participants. Table 31 displays the demographic characteristics of the children in this sample.
Table 31 Demographic characteristics of the study participants with school trip data

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Group</th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td>129</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td></td>
<td>64</td>
<td>46.6</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td>65</td>
<td>53.4</td>
</tr>
<tr>
<td>Age (years)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td></td>
<td>12</td>
<td>9.5</td>
</tr>
<tr>
<td>12</td>
<td></td>
<td>96</td>
<td>76.2</td>
</tr>
<tr>
<td>13</td>
<td></td>
<td>17</td>
<td>13.5</td>
</tr>
<tr>
<td>14</td>
<td></td>
<td>1</td>
<td>0.8</td>
</tr>
<tr>
<td>Mean (SD)</td>
<td></td>
<td>12.1 ± 0.5</td>
<td></td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td></td>
<td>52</td>
<td>40.3</td>
</tr>
<tr>
<td>Māori</td>
<td></td>
<td>47</td>
<td>36.4</td>
</tr>
<tr>
<td>Pacific</td>
<td></td>
<td>30</td>
<td>23.3</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>129</td>
<td></td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td></td>
<td>76</td>
<td>58.9</td>
</tr>
<tr>
<td>Overweight</td>
<td></td>
<td>33</td>
<td>25.6</td>
</tr>
<tr>
<td>Obese</td>
<td></td>
<td>20</td>
<td>15.5</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>129</td>
<td></td>
</tr>
<tr>
<td>School stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td></td>
<td>44</td>
<td>34.1</td>
</tr>
<tr>
<td>Medium</td>
<td></td>
<td>37</td>
<td>28.7</td>
</tr>
<tr>
<td>High</td>
<td></td>
<td>48</td>
<td>37.2</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>129</td>
<td></td>
</tr>
</tbody>
</table>

¹Age data missing for 3 participants

Number of journeys to and from school

Participants recorded a mean of 3.1 journeys (hereafter trips) to or from school over the two-day collection period. The mean number of trips recorded was similar across participants from all three ethnic groups and decile strata. Table 32 displays the total number of trips recorded and their associated frequency among the participants.

Table 32 Total number of recorded trips to and from school and their associated frequency

<table>
<thead>
<tr>
<th>Total number of trips</th>
<th>Frequency (n)</th>
<th>Percentage (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>11</td>
<td>8.5</td>
</tr>
<tr>
<td>2</td>
<td>25</td>
<td>19.4</td>
</tr>
<tr>
<td>3</td>
<td>30</td>
<td>23.3</td>
</tr>
<tr>
<td>4</td>
<td>63</td>
<td>48.8</td>
</tr>
<tr>
<td>Total</td>
<td>403</td>
<td>100</td>
</tr>
</tbody>
</table>
Duration of each trip to or from school

Children collected a median of 96.3 images during each trip to or from school. Assuming that each image contributed 7 seconds of recording time, this equated to a median duration of 11.1 minutes per trip. Table 33 displays the variation in the number of images (and therefore trip duration) collected by the participants.

Table 33 Number, equivalent duration (minutes) and distribution of images collected per trip to or from school

<table>
<thead>
<tr>
<th>Percentiles</th>
<th>Total number of images</th>
<th>Total recording duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum</td>
<td>0.3</td>
<td>0.0</td>
</tr>
<tr>
<td>Lower quartile</td>
<td>34.5</td>
<td>4.0</td>
</tr>
<tr>
<td>Median</td>
<td>96.3</td>
<td>11.1</td>
</tr>
<tr>
<td>Upper quartile</td>
<td>218.5</td>
<td>25.5</td>
</tr>
<tr>
<td>Maximum</td>
<td>1092.0</td>
<td>127.4</td>
</tr>
</tbody>
</table>

The number of images collected on the trip to or from school varied by ethnicity and school decile stratum. As shown in Table 34, NZ European children collected the greatest median number of images per trip (153.5), and Pacific children had the least (74.0). The highest median number of images was collected by children from high decile schools while children from low decile schools collected the lowest median number of images. The median duration of each trip was highest among children from high and medium decile schools and among NZ European children.

Table 34 Median number of images collected per trip by ethnicity and school decile stratum during both school days

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Group</th>
<th>Median number of images</th>
<th>Median recording duration (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td>NZ European</td>
<td>153.5</td>
<td>17.9</td>
</tr>
<tr>
<td></td>
<td>Māori</td>
<td>80.0</td>
<td>9.3</td>
</tr>
<tr>
<td></td>
<td>Pacific</td>
<td>74.0</td>
<td>8.6</td>
</tr>
<tr>
<td>School decile stratum</td>
<td>Low</td>
<td>70.8</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>Medium</td>
<td>95.5</td>
<td>11.2</td>
</tr>
<tr>
<td></td>
<td>High</td>
<td>153.5</td>
<td>17.9</td>
</tr>
</tbody>
</table>
Proportion of time spent in each outdoor setting

The mean proportions of time participants spent in each outdoor setting were calculated for the sample to determine where they spent their time on their journeys to or from school. As displayed in Figure 23, children spent the greatest proportion of each trip in the street setting (65.1%), followed by outdoor recreation (13.2%) and sports settings (12.9%). It is likely that the latter two settings were captured as children walked through parks, walking tracks and sports grounds on their journeys. Participants spent a mean of 3.9% of their trip in the shop front setting and a similar mean proportion at public transport facilities (3.4%). On average, children spent negligible time at fresh food markets and service station forecourts during the trip to or from school.

Figure 23 Mean proportion of time spent in each setting during the trip to or from school

Gender

There were few differences in the proportion of time spent in each outdoor setting between male and female participants (Figure 24). However, there was a pronounced difference in the proportion of time spent in public transport facilities.
by gender. Male participants spent a mean of 4.9% of trip time in this setting compared to a mean of 1.8% among female participants. This result may suggest that a greater number of male than female participants used public transport to travel to and from school in this study.

Figure 24 Mean proportion of time spent in each setting during the trip to or from school by gender

Ethnicity

Figure 25 displays the proportion of time the participants spent in each setting by ethnic group. Children from all ethnic groups spent the greatest proportion of their time in the street, outdoor recreation and sports settings. However, Māori participants spent a greater proportion (6.2%) of their time in the shop front setting than Pacific (4.1%) and NZ European (3.3%) participants. On average, the proportion of time participants spent in public transport facilities on the trip to or from school was low for Māori (0.4%) and Pacific (1.1%) participants. Comparatively, NZ European participants spent a mean of 4.7% of their trip time at public transport facilities. Interestingly, Pacific children spent a mean of 3.4% of their trip time at fresh food markets.
The mean proportion of time the children spent in each outdoor setting by school decile stratum were similar for most settings, with the largest differences observed in the shop front and public transport facility settings. On average, children from the high decile strata spent a greater proportion of their trip time in the sports setting than children from low and medium school decile strata. As shown in Figure 26, participants from the high and medium school decile strata spent the same mean amount of time (3.5%) in the shop front setting when travelling to or from school. However, participants from low decile strata spent a mean of 6.0% of their time in this setting. This greater proportion may not represent actual differences in time spent in the shop front setting but rather may reflect a more limited number of outdoor settings visited during the trip to or from school. Marked differences were also found among participants from different strata in the proportion of time spent at public transport facilities. Children from the high decile strata spent a mean of 5.3% of their trip time at public transport facilities.

Figure 25 Mean proportion of time spent in each setting during the journey to or from school by ethnic group

School decile stratum

The mean proportion of time the children spent in each outdoor setting by school decile stratum were similar for most settings, with the largest differences observed in the shop front and public transport facility settings. On average, children from the high decile strata spent a greater proportion of their trip time in the sports setting than children from low and medium school decile strata. As shown in Figure 26, participants from the high and medium school decile strata spent the same mean amount of time (3.5%) in the shop front setting when travelling to or from school. However, participants from low decile strata spent a mean of 6.0% of their time in this setting. This greater proportion may not represent actual differences in time spent in the shop front setting but rather may reflect a more limited number of outdoor settings visited during the trip to or from school. Marked differences were also found among participants from different strata in the proportion of time spent at public transport facilities. Children from the high decile strata spent a mean of 5.3% of their trip time at public transport facilities.
facilities compared to 0.6% and 0.7% for participants from low and medium decile strata, respectively.

**BMI Category**

There were some differences in the proportion of time children spent in outdoor settings on their journeys to or from school by BMI category. As shown in Figure 27, children categorised as obese spent a larger proportion of their time in the street and shop front settings than children in the healthy and overweight BMI categories. Children in the healthy and overweight BMI categories spent greater proportions of their time in the outdoor recreation and sports settings than children in the obese BMI category. Overall, all children spent the greatest proportion of their trip times in the street setting.

**Figure 26 Mean proportion of time spent in each setting during the journey to or from school by school decile stratum**
Figure 27 Mean proportion of time spent in each setting during the trip to or from school by BMI category

Summary

The street, outdoor recreation settings and sports settings were those in which children spent the majority of time during their trip to and from school. The finding that children spent approximately 4.0% of their time in the shop front setting indicates that many of them passed through shopping areas on their journeys. Furthermore, time spent in public transport facilities appears to be an important component of the trip for some participants (especially NZ European boys from high decile schools). Children spent negligible time at fresh food markets and service station forecourts during their journeys. As such, these settings were excluded from further analyses.
Median rates of exposure to non-core and core food advertising on the trip to or from school

This section reports on the individual rates of non-core and core food advertising exposures, calculated for each participant, to describe inter-participant variation in exposure rates. Table 35 displays the proportion of children with low (<1), moderate (≥1 and <5) and high (≥5) rates of exposure to non-core and core advertising.

Non-core
On the trip to or from school, almost three-quarters (72.5%) of participants had low rates of exposure to non-core food advertising, capturing less than one exposure per trip. However, as shown in Table 35, over one quarter of participants had a median of between 1 and 5 non-core advertising exposures per trip to or from school, and there were marked differences between demographic groups. A higher proportion of NZ European and Māori children had moderate and high rates of exposure on their trips to or from school than Pacific children. Further, participants from schools in the medium and high school decile strata had greater proportions of children with a moderate number of non-core exposures per trip than those from schools in the low school decile stratum. There were also differences in exposure rate by BMI category. The obese BMI category had the largest proportion of children with high exposure rates. However, overall, the healthy weight category had the largest proportion of children with moderate and high exposure rates. Further, a greater proportion of female participants had moderate or high numbers of exposures per trip than male participants.
Table 35 Proportion of participants with low, moderate and high exposures to non-core advertising per trip by ethnicity, school decile stratum, BMI and gender¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Proportion with low exposure &lt;1 exposure per trip</th>
<th>Proportion with moderate exposure ≥1 and &lt;5 exposures per trip</th>
<th>Proportion with high exposure ≥5 exposures per trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>72.5</td>
<td>26.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ</td>
<td>69.5</td>
<td>30.5</td>
<td>0.0</td>
</tr>
<tr>
<td>European</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>69.3</td>
<td>24.6</td>
<td>6.1</td>
</tr>
<tr>
<td>Pacific</td>
<td>92.0</td>
<td>8.0</td>
<td>0.0</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>88.8</td>
<td>9.2</td>
<td>2.0</td>
</tr>
<tr>
<td>Medium</td>
<td>70.5</td>
<td>29.5</td>
<td>0.0</td>
</tr>
<tr>
<td>High</td>
<td>69.1</td>
<td>29.7</td>
<td>1.3</td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>64.9</td>
<td>34.0</td>
<td>1.1</td>
</tr>
<tr>
<td>Overweight</td>
<td>89.0</td>
<td>11.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Obese</td>
<td>81.8</td>
<td>14.4</td>
<td>3.8</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>65.5</td>
<td>32.9</td>
<td>1.6</td>
</tr>
<tr>
<td>Male</td>
<td>78.9</td>
<td>20.5</td>
<td>0.6</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

Core

The proportion of participants with low, moderate and high rates of core advertising exposure on the trip to or from school are presented in Table 36 by ethnic group, school decile strata, BMI category and gender group. Exposures to core advertising on the trip to or from school were low across all participants, with 96.7% of participants capturing less than one core advertisement per trip. The proportion of children with moderate exposures was highest among Māori participants; those from high decile schools, those in the overweight BMI category and males.
Table 36 Proportion of participants with low, moderate and high exposures to core advertising per trip by ethnicity, school decile stratum, BMI and gender¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Proportion with low exposure &lt;1 exposure per trip</th>
<th>Proportion with moderate exposure ≥1 and &lt;5 exposures per trip</th>
<th>Proportion with high exposure ≥5 exposures per trip</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>96.8</td>
<td>3.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>96.9</td>
<td>3.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Māori</td>
<td>93.9</td>
<td>6.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Pacific</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>98.0</td>
<td>2.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Medium</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>High</td>
<td>95.2</td>
<td>4.8</td>
<td>0.0</td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>98.8</td>
<td>1.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Overweight</td>
<td>91.3</td>
<td>8.7</td>
<td>0.0</td>
</tr>
<tr>
<td>Obese</td>
<td>96.9</td>
<td>3.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>98.5</td>
<td>1.5</td>
<td>0.0</td>
</tr>
<tr>
<td>Male</td>
<td>95.2</td>
<td>4.8</td>
<td>0.0</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

**Median rates of exposure to food advertising by setting**

The rates of non-core and core advertising exposure, per trip were low across all settings. The street, shop front, public transport and sports setting were the only settings in which participants were exposed to food advertising (both non-core and core) on the trip to or from school. Only 32 children had non-core exposures in the street setting, 37 had non-core exposures in the shop front setting, six had non-core exposures at public transport facilities, and two had non-core advertising in the sports setting. Nineteen children had core exposures in the shop front setting, four in the street setting, and one at a public transport facility. As a result, the data is skewed in its distribution. The proportion of children with low, moderate and high rates of non-core and core advertising exposures in each outdoor setting are presented in Table 37.
Table 37 Proportion of participants with low, moderate and high exposures to non-core and core advertising per trip by outdoor setting¹

<table>
<thead>
<tr>
<th>Setting</th>
<th>Proportion with low exposure &lt;1 exposure per trip</th>
<th>Proportion with moderate exposure ≥1 and &lt;5 exposures per trip</th>
<th>Proportion with high exposure ≥5 exposures per trip</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-core</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street</td>
<td>94.8</td>
<td>5.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Shop front</td>
<td>82.5</td>
<td>16.8</td>
<td>0.7</td>
</tr>
<tr>
<td>Fresh food market</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Public Transport Facility</td>
<td>97.9</td>
<td>2.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Sport</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Outdoor recreation</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Service station forecourt</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td><strong>Core</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Street</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Shop front</td>
<td>97.2</td>
<td>2.8</td>
<td>0.0</td>
</tr>
<tr>
<td>Fresh food market</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Public Transport Facility</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Sport</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Outdoor recreation</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Service station forecourt</td>
<td>100</td>
<td>0.0</td>
<td>0.0</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

**Median rates of advertising exposure by food product category**

Table 38 displays the median rates of exposure to non-core outdoor food advertising on the trip to or from school, by product category. The rates of exposure to non-core advertising on journeys to or from school were highest for the fast food, sugary drinks, ice cream, and cookies product categories. For the remaining product categories, exposures on the trip to or from school were low, with all participants capturing less than one exposure per trip.
Table 38 Proportion of participants with low, moderate and high exposures to non-core advertising per trip by food product category

<table>
<thead>
<tr>
<th>Food product category</th>
<th>Proportion with low exposure</th>
<th>Proportion with moderate exposure</th>
<th>Proportion with high exposure</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt;1 exposure per trip</td>
<td>≥1 and &lt;5 exposures per trip</td>
<td>&gt;5 exposures per trip</td>
</tr>
<tr>
<td>Total non-core</td>
<td>72.5</td>
<td>26.4</td>
<td>1.1</td>
</tr>
<tr>
<td>Fast food</td>
<td>86.9</td>
<td>12.3</td>
<td>0.8</td>
</tr>
<tr>
<td>Sugary drinks</td>
<td>96.1</td>
<td>3.9</td>
<td>0.0</td>
</tr>
<tr>
<td>Ice cream</td>
<td>96.8</td>
<td>3.2</td>
<td>0.0</td>
</tr>
<tr>
<td>Cookies</td>
<td>98.9</td>
<td>1.1</td>
<td>0.0</td>
</tr>
<tr>
<td>Confectionery</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Snack foods</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Diet drinks</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Unhealthy cereals</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Other</td>
<td>100.0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Total Core</td>
<td>96.8</td>
<td>3.2</td>
<td>0.0</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

Mean rates of exposure to non-core and core advertising on the trip to or from school

This section presents the results of the Poisson regression analyses. The mean rates of non-core and core advertising exposure are presented alongside rate ratios (RR) comparing mean rates between ethnic groups, school decile strata, BMI categories, and gender groups. Mean rates of non-core and core advertising exposure per trip are also presented for each outdoor setting and by food product category.

Exposure to non-core and core advertising

During each trip to or from school, participants encountered a mean of 0.8 (95%CI 0.7 to 0.9) outdoor food advertisements. Participants were exposed to a mean of 0.7 (95%CI 0.7 to 0.8) non-core and 0.1 (95%CI 0.1 to 0.1) core outdoor food advertisements on the trip to or from school. Therefore, children in this study were exposed to non-core outdoor food advertising at a rate almost seven times that of core outdoor food advertising on the trip to or from school. Examples of
core and non-core advertising captured on the trip to or from school are circled in Figure 28.

![Non-core (ice cream) and core (milk) outdoor advertising on the journey home from school](image)

**Figure 28 Non-core (ice cream) and core (milk) outdoor advertising on the journey home from school**

**Rates of non-core food advertising exposure by ethnicity, school decile stratum, BMI category and gender**

Table 39 presents the mean rates (95%CI) of non-core advertising exposure per trip, together with rate ratios (95%CI) comparing mean rates between demographic categories. The mean rates of exposure to non-core advertising were similar across ethnic groups, with no statistically significant differences observed.

The results indicate that Māori participants had double (RR 2.0, 95%CI 0.6 to 6.7) the rate of exposure to non-core outdoor advertising per trip than NZ Europeans participants. However, this difference was not statistically significant. There were also differences in non-core exposure rates by school decile stratum. Participants from the medium and high decile schools had non-core exposure rates that were 40% and 60% higher, respectively, than those from low decile schools. However,
these differences in the mean rates of non-core exposure were not statistically significant.

The rates of exposure varied between participants from the three different BMI categories. Children with a healthy weight for their age and gender had a similar rate of exposure to non-core advertising per trip as those children classified as obese. However, participants from the overweight category had a mean of 0.2 (95%CI 0.1 to 0.6) exposures per trip. As shown in Table 39 the mean rate was significantly lower (RR 0.2, 95%CI 0.1 to 0.8) for this group than for those in the healthy weight category. Mean rates were similar between gender groups.

Table 39 Mean rates (with 95% confidence intervals) of exposure from Poisson regression for non-core advertising per trip by ethnic group, school decile stratum, BMI and gender¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Mean rate of non-core exposure per trip (95% CI)</th>
<th>Rate ratio between groups (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>0.6 (0.2-1.5)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>1.2 (0.6-2.7)</td>
<td>2.0 (0.6-6.7)</td>
<td>0.230</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.4 (0.1-1.4)</td>
<td>0.7 (0.2-3.1)</td>
<td>0.647</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.5 (0.2-1.3)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>0.7 (0.3-1.6)</td>
<td>1.4 (0.4-5.5)</td>
<td>0.566</td>
</tr>
<tr>
<td>High</td>
<td>0.7 (0.3-1.8)</td>
<td>1.6 (0.4-6.1)</td>
<td>0.460</td>
</tr>
<tr>
<td>BMI Category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>0.8 (0.5-1.5)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>0.2 (0.1-0.6)</td>
<td>0.2 (0.1-0.8)</td>
<td>0.021</td>
</tr>
<tr>
<td>Obese</td>
<td>0.8 (0.3-2.2)</td>
<td>0.9 (0.4-2.4)</td>
<td>0.874</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.8 (0.4-1.6)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.6 (0.3-1.2)</td>
<td>0.8 (0.4-1.5)</td>
<td>0.422</td>
</tr>
</tbody>
</table>

¹Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children
²Shaded rows denote statistically significant results

**Adjusted rate ratios of non-core food advertising exposure by ethnicity and school decile stratum**

The results of the adjusted model of analysis are presented in Table 40. After adjusting for the potential effects of ethnicity and school decile stratum, the rate ratio comparing mean rates between Māori and NZ European participants increased. Although this result was not statistically significant, it suggests that
Māori participants were exposed to outdoor non-core food advertising more frequently during their trip to or from school than NZ European children.

In the results from the adjusted regression model, controlling for ethnicity, the rate ratios comparing the exposure rates per trip between participants from the medium and low decile schools, and the high and low decile schools increased to 2.5 (95%CI 0.8 to 7.8). Although these results were not statistically significant, they suggest that children from medium and high decile schools may be exposed to more outdoor food advertising on the trip to or from school than those from low deciles schools.

Table 40 Rate ratios (with 95% confidence intervals) from Poisson regression models for non-core exposure rates accounting for school decile stratum (model 1) and ethnicity (model two)¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Rate ratio between groups (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>2.5 (0.8-7.8)</td>
<td>0.103</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.0 (0.2-4.1)</td>
<td>0.947</td>
</tr>
<tr>
<td>School stratum</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>2.0 (0.5-8.0)</td>
<td>0.305</td>
</tr>
<tr>
<td>High</td>
<td>2.3 (0.7-7.7)</td>
<td>0.181</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

**Exposure to core food advertising**

**Rates of exposure to core food advertising by ethnicity, school decile stratum, BMI category and gender**

The mean rates of exposure to core food advertising per trip by ethnic group, school decile stratum, BMI category and gender are displayed in Table 41. As shown in Table 41, Māori participants had 2.5 (95%CI 0.5 to 12.1) times the mean rate of exposure to outdoor core advertising per trip to or from school than NZ European participants. However, this finding was not statistically significant (p=0.234). As with the rates of exposure to non-core outdoor food advertising, participants from medium and high decile schools had higher mean rates of
exposure to core advertising on their trips to or from school. Although, again, these difference were not statistically significant. Male and female participants had very similar mean rates of exposure to core advertising on the trip to or from school.

Table 41 Mean rates (with 95% confidence intervals) of exposure from Poisson regression to core advertising per trip by ethnic group, school decile stratum, BMI category and gender¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Mean rate of core exposures per trip (95% CI)</th>
<th>Rate ratio between groups (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>0.1 (0.0-0.2)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>0.2 (0.1-0.4)</td>
<td>2.5 (0.5-12.1)</td>
<td>0.234</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.1 (0.0-0.2)</td>
<td>0.9 (0.1-5.8)</td>
<td>0.880</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.0 (0.0-0.2)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>0.1 (0.0-0.5)</td>
<td>1.9 (0.1-23.1)</td>
<td>0.612</td>
</tr>
<tr>
<td>High</td>
<td>0.1 (0.0-0.3)</td>
<td>2.4 (0.4-16.9)</td>
<td>0.341</td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>0.1 (0.0-0.2)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>0.1 (0.0-0.3)</td>
<td>0.7 (0.2-2.4)</td>
<td>0.520</td>
</tr>
<tr>
<td>Obese</td>
<td>0.0 (0.0-0.2)</td>
<td>0.5 (0.2-1.5)</td>
<td>0.231</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.1 (0.0-0.1)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>0.1 (0.0-0.3)</td>
<td>1.1 (0.4-3.8)</td>
<td>0.823</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

**Adjusted rate ratios of core food advertising exposure by ethnicity and school decile stratum**

The results from the adjusted Poisson regression model are presented in Table 42. After controlling for school decile stratum, Māori participants had a rate of exposure to core outdoor food advertising that was 3.4 (95%CI 0.8 to 15.2) times that of NZ European children. However, this difference was not statistically significant. Similarly, after controlling for ethnicity, the rate ratios comparing the mean rates of core exposure among participants from medium and high decile schools to those from low decile schools increased. This increase was most pronounced for participants from high decile schools, who had a mean rate of core exposure per trip that was 4.1 (95%CI 0.7 to 24.6) times that of children from low decile schools. Although these results were not statistically significant, they may
suggest that those from higher decile schools encountered a greater number of outdoor core food advertisements on their journeys to or from school.

Table 42  Rate ratios (with 95% confidence intervals) from Poisson regression models for core exposure rates per trip accounting for school decile stratum (model 1) and ethnicity (model two)\(^1\)

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Rate ratio between groups (95% CI)</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZ European</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>3.4 (0.8-15.2)</td>
<td>0.096</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.3 (0.2-9.0)</td>
<td>0.755</td>
</tr>
<tr>
<td><strong>School stratum</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>3.0 (0.3-32.1)</td>
<td>0.343</td>
</tr>
<tr>
<td>High</td>
<td>4.1 (0.7-24.6)</td>
<td>0.111</td>
</tr>
</tbody>
</table>

\(^1\) Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

**Mean rates of non-core and core food advertising exposure by outdoor setting**

Table 43 displays the mean rates of children’s exposure to non-core and core advertising in each outdoor setting. On their trips to or from school, participants only captured food advertising in four outdoor settings. The majority of non-core advertising exposures on the trip to or from school occurred in the shop front and street settings. Only a small number of non-core advertising exposures were captured in the sport and public transport facility settings. As such, the mean rate of exposure was zero in both settings.

The rate of core exposures was highest in the shop front setting with a mean rate of 0.1 (95%CI 0.1 to 0.1) exposures per trip. A very small number of core exposures were captured in the street (n=4) and at public transport facilities (n=1), giving a mean rate of exposure of zero per trip in both settings.
### Table 43 Mean rates (with 95% confidence intervals) of exposure from Poisson regression for non-core and core food advertising per trip by setting

<table>
<thead>
<tr>
<th>Setting</th>
<th>Mean rate of non-core exposure to food advertising per trip (95% CI)</th>
<th>Mean rate of core exposure to food advertising per trip (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shop front</td>
<td>0.5 (0.4-0.6)</td>
<td>0.1 (0.1-0.1)</td>
</tr>
<tr>
<td>Street</td>
<td>0.2 (0.2-0.3)</td>
<td>0.0 (0.0-0.0)</td>
</tr>
<tr>
<td>Sport</td>
<td>0.0 (0.0-0.0)</td>
<td>-</td>
</tr>
<tr>
<td>Public transport facility</td>
<td>0.0 (0.0-0.1)</td>
<td>0.0 (0.0-0.0)</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children

### Mean rates of exposure to non-core advertising by food product category

The mean rates of exposure to non-core food advertising by product category are displayed in Table 44. Outdoor advertisements for fast food were the most frequently encountered on the trip to or from school, followed by advertisements for products in the sugary drinks, ice-cream, and cookies categories. An example of fast food advertising captured on the trip home from school is displayed in Figure 29. A small number of exposures to advertising for confectionery and snack foods were also captured. However, the mean rate of exposure to advertising for the latter two categories was zero per trip.

### Table 44 Mean rates (with 95% confidence intervals) of exposure from Poisson regression to non-core advertising by food product category

<table>
<thead>
<tr>
<th>Product category</th>
<th>Mean rate (95%-CI) advertising exposure per trip by non-core product category</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fast food</td>
<td>0.4 (0.3-0.5)</td>
</tr>
<tr>
<td>Sugary drinks</td>
<td>0.1 (0.1-0.2)</td>
</tr>
<tr>
<td>Ice cream</td>
<td>0.1 (0.1-0.2)</td>
</tr>
<tr>
<td>Cookies</td>
<td>0.1 (0.1-0.1)</td>
</tr>
<tr>
<td>Confectionery</td>
<td>0.0 (0.0-0.0)</td>
</tr>
<tr>
<td>Snack foods</td>
<td>0.0 (0.0-0.0)</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children
Chapter summary

On the trip to and from school, participants were exposed to a mean of 0.8 outdoor food advertisements per trip, of which a mean of 0.7 were for non-core food advertisements and 0.1 were for core food advertisements. Extrapolated over the five-day school week, assuming the same travel route, children would see a mean of 7 non-core outdoor food advertisements on their trip to or from school per week. These results do not include exposures in malls, supermarkets, convenience stores or other food retail outlets on the same journey. The majority of non-core advertising exposures occurred in the shop front and street settings. Children spent a mean of only 3.9% of their trip time in the shop front setting. However, the highest rate of both non-core and core advertisements were recorded in this setting, suggesting that outdoor advertising exposures on the trip to or from school are largely associated with retail food outlets. Fast food, sugary drinks, ice cream and cookies, cakes and pastries were the most commonly advertised food products captured on the trip to or from school.

The results indicate that there may be some variation in exposure rates to non-core advertising on the trip to or from school by key demographic factors. Māori participants had twice the rate of non-core outdoor food advertising exposure on the trip to or from school than NZ European children. Further, participants from medium and high decile schools had greater rates of non-core exposure than those...
from low decile schools. Interestingly, participants in the overweight BMI category had a rate of exposure to non-core advertising 80% lower than those in the healthy weight category. There were no significant differences in non-core or core food advertising exposure by school decile strata or ethnic group.

Exposures to core food advertising occurred at a mean rate of 0.1 exposures per trip, one seventh of the rate of non-core food advertising, and were most common in the shop front setting. Based on the results of this research, children would encounter an average of only one core outdoor advertisement over the course of each school week during their trip to or from school. Demographic differences in core exposure rates followed a similar trend to non-core exposure rates on the trip to and from school. Māori participants had mean exposure rates to core advertising that were 2.5 times higher than those of NZ European children. Children from medium and high decile schools also had greater rates of exposure to core advertising than those from low decile schools. Overall, non-core and core food advertising exposures on the trip to or from school were highest in the shop front setting and among Māori participants, and those from medium and high decile schools.

The following chapter summarises the key findings of this thesis, compares the results to the existing literature on outdoor food advertising, and outlines the strengths and limitations of this thesis. The implications of these findings for policy and practice are also discussed. The final section concludes this thesis.
Chapter Eight: Discussion

Introduction

This chapter provides a summary of the main findings of this thesis and discusses these in the context of the existing literature on outdoor food advertising. This is followed by a discussion of the strengths and limitations of this research. The implications of this work are then discussed, including the implications for policy. The chapter ends with the overall conclusions drawn from this thesis.

Childhood obesity is a growing concern internationally and in New Zealand. Globally, the number of children who are overweight or obese has risen by 47.1% in just three decades and is now a leading cause of preventable disease (Ng et al., 2014). Food marketing is a recognised contributor to the development of childhood obesity owing to its influence on children's food preferences, consumption, purchasing behaviour, and nutritional knowledge (Cairns et al., 2009; Cairns et al., 2013; World Health Organization, 2004; World Health Organization, 2010; World Health Organization, 2016). Food marketing is a pervasive presence in children's lives and, as demonstrated in the present research and wider Kids'Cam food advertising research (Signal, Stanley, et al., 2017), is marketed to them using a variety of different media, including outdoor advertising. Although the extent and nature of outdoor food advertising have been described previously (Adams et al., 2011; Gebauer & Laska, 2011; Isgor et al., 2016; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005; Powell et al., 2012; Settle et al., 2014), little was known about children's actual exposure to outdoor food and beverage advertising.

In previous research, outdoor food advertising has been measured using cross-sectional observational studies employing purpose-developed environmental survey tools (Adams et al., 2011; Gebauer & Laska, 2011; Isgor et al., 2016; Settle et al., 2014). Estimating children's exposure to outdoor food marketing has typically involved the researcher recording all visible marketing within a defined geographical area that was assumed to represent the child's neighbourhood or in
places that children are known to frequent (Gebauer & Laska, 2011; Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005; Walton et al., 2009). As discussed in Chapter Three, these methods are effective in describing the nature and extent of outdoor food advertising. However, they cannot be used to accurately determine children’s exposure to outdoor advertising.

This thesis has focussed on the contribution of outdoor food marketing to the obesogenic environments in which children live. It sought to investigate the extent and nature of children’s exposure to outdoor food and beverage advertising, and to assess how exposures differed by key sociodemographic variables. This research also sought to determine the extent and nature of children’s exposure to core and non-core outdoor food advertising on their journeys to or from school, and to determine the most frequently advertised non-core food groups in outdoor settings.

The following sections provide a summary of the main findings as they relate to each of the three research questions. Further, the main findings of this research are discussed as they relate to core aspects of the marketing mix, specifically, the extent of the advertising children encountered in outdoor settings (promotion), the location of the outdoor food advertisements captured by the participants (place), and the types of food and beverage products advertised in outdoor settings (product).

**The extent and nature of children’s exposure to non-core and core outdoor food advertising (promotion)**

To our knowledge, this is the first study to investigate and quantify the rate at which children are exposed to food advertising in outdoor settings using objective wearable camera data, collected by the participants. The findings of this thesis indicate that outdoor advertising is an important contributor to children’s overall exposure to food marketing.

In this study, participants collected a median of 44.2 minutes of data in outdoor settings over the four day data collection period, or a median of approximately 11 minutes per day. On average, children spent 67.2% of their outdoor time in street...
settings, and approximately 13% of their outdoor time in outdoor recreation and sports settings, respectively. Children in this study spent a mean of 4.4% of their outdoor time at shop fronts, 1.3% at public transport facilities, and 0.9% of their time at fresh food markets.

Overall, children encountered a mean of 8.3 (95%CI 7.9 to 8.7) food advertisements for every hour they spent in outdoor settings. Of these exposures, 7.4 (95%CI 7.0 to 7.8) or 89.2% were for non-core food products and 0.8 (95%CI 0.7 to 1.0) or 9.6% were for core food products. Outdoor food advertising exposures occurred primarily at shop fronts, on the street, and at fresh food markets. The most frequently encountered non-core food advertisements were for fast food, sugary drinks, ice cream, cookies, and confectionery. Interestingly, advertisements for diet drinks, snack foods, and high sugar low fibre breakfast cereals were seldom captured in this study.

**Location of outdoor advertising (place)**

Exposures to non-core and core food advertising in this study primarily occurred at shop fronts, in the street, and at fresh food markets. The highest non-core advertising exposure rates were observed in the shop front (4.7 exposures per hour spent outdoors) followed by the street (1.7 exposures per hour) and fresh food market (0.4 exposures per hour) settings. In these settings, the highest rates of exposure to core advertising were also recorded with a mean rate of 0.4 (95%CI 0.4 to 0.5) core exposures in the shop fronts setting, 0.2 (95%CI 0.1 to 0.3) exposures in the street setting, and 0.2 (95%CI 0.1 to 0.2) exposures per hour at fresh food markets for every hour spent in outdoor settings.

As discussed in Chapter Three, outdoor food advertising is typically associated with retail outlets. Although the type of shop front (on which food advertising was present) was not recorded in the present research, my experience of coding the image data suggests that the outdoor food advertising captured on shop fronts was largely at convenience stores and fast food outlets. Further, the results of the present study are consistent with the international research which reports that outdoor food advertising is frequently found on the exterior of supermarkets, convenience stores and fast food outlets (Gebauer & Laska, 2011; Isgor et al,
In a national survey of 8959 supermarkets and convenience stores in the US, a reported 73% of convenience stores and almost 59% of supermarkets/grocery stores had shop front or other external advertising (Isgor et al., 2016). Similarly, a study of 63 convenience stores found within 800m of 26 Minnesota secondary schools revealed that 83% of the convenience stores had external food advertisements (Gebauer & Laska, 2011). Research from the US also suggests that external advertising is frequently found on fast food outlets (Powell et al., 2012). In their national survey of fast food outlets, Powell et al. (2012) reported that 80% of all outlets had external food advertising, with 91% of chain fast food outlets displaying food advertising on the exterior of their buildings. The findings of the present research are also supported by earlier New Zealand research that reported, 96.5% of outdoor food advertising within a 1km radius of 10 secondary schools was associated with food retail outlets (Maher et al., 2005).

Children's high rates of exposure to non-core food advertising on shop fronts in this study are concerning as outdoor advertising at the point of sale acts as a prompt to remind the consumer of the product at the time and place of purchase (Bhargava & Donthu, 1999). As discussed above, the outdoor food advertising to which children were exposed in the current study was primarily for fast food, sugary drinks and ice cream, likely at food stores.

Previous research on outdoor food marketing suggests that free-standing billboards and signs, and posters, banners and other large outdoor food advertisements are common along the main streets of many cities worldwide (Adams et al., 2011; Hillier et al., 2009; Kelly, Cretikos, et al., 2008; Lesser et al., 2013). The results of the current research suggest that the Wellington region is similar, as children were exposed to an average of 1.7 non-core outdoor food advertisements for every hour they spent in the street setting. Analysis of the image data in the current study indicated that there were few outdoor food advertisements on small suburban streets, that is, outside of main streets. Other studies report that outdoor advertising is commonly placed in main streets due to the high reach and impact of advertising in this setting, and the potential for
repeated brand exposures, particularly along main roads and commuting routes (Bhargava & Donthu, 1999; Taylor et al., 2006).

An unexpected finding from this thesis was the relatively high rate of exposure to non-core advertising at fresh food markets. Children were exposed to an average of 0.4 non-core advertising exposures in this setting per hour spent outdoors. A likely explanation for this finding is that fresh food markets in the Wellington region often have mobile food vendors selling fast food and drinks. My impression from coding the image data is that many of these exposures were advertisements for the food vendors, advertising the availability of non-core foods, typically fast food and sweet drinks. This finding suggests that there is potential for intervention to improve the food and beverage environment at fresh food markets. Fresh food markets are an important food source for Wellington residents, particularly Māori and Pacific residents, with five fresh food markets located throughout the region.

As discussed in Chapter Six, there were few food advertising exposures captured in outdoor recreation and sports settings, and at public transport facilities. After the street setting (67.2%), children spent the greatest proportion of their outdoor time in the outdoor recreation (13.2%) and sports (12.8%) settings. Exposures to outdoor food advertising (non-core and core) were among the lowest in the outdoor recreation and sports settings. As the outdoor recreation setting included parks, walking tracks, beaches, and rivers it is unsurprising that there were few exposures to outdoor food advertising in these settings. However, this is an encouraging finding as it appears that, in the Wellington region, these spaces may be largely free of outdoor food advertising. In the sports setting, children were exposed to outdoor advertising at a mean rate of 0.3 non-core and 0.0 core exposures per hour. This rate is likely an underestimate as children were instructed to remove the camera before engaging in vigorous sport and may have taken the camera off before entering sports grounds when going for this reason. Mean rates of non-core and core food advertising were also low at public transport facilities. In this setting, children in this study were exposed to 0.1 non-core and 0.0 core food advertisements per hour.
Overall these findings highlight that children are exposed to food advertising in everyday settings, primarily at shop fronts, in the street, and at fresh food markets.

**Children’s places in adult worlds**

As discussed in Chapter Three, children’s places are not typically conceptualised as those that are shared by both adults and children. Children’s places are largely conceptualised as being child-serving institutions (e.g. schools), recreation facilities, and the home (Carroll, Witten, Kearns, et al., 2015; Rasmussen, 2004). However, the findings of this study suggest that children gather and spend time in the street setting and in shopping areas, places not typically thought of as children’s places. Previous research on children’s use and experience of public space collectively reports that children often spend time in the street walking to and from school (or between activities), and use the street to socialise and play (Carroll, Witten, & Kearns, 2015; Carroll, Witten, Kearns, et al., 2015; Elsley, 2004; Freeman, 2010; Matthews, 2003). Although adults often view the street as a transitory place, passed through on the way to a destination, the evidence suggests that the street is an important ‘third place’ for children. The street provides a place outside of the home (first place) and school (second place) for social interaction with peers, informal games, and other recreation activities (Carroll, Witten, & Kearns, 2015; Elsley, 2004; Matthews, 2003). Research suggests that children commonly spend a large proportion of their leisure time playing in the street, and visiting shopping complexes and retail outlets (Carroll, Witten, & Kearns, 2015; Carroll, Witten, Kearns, et al., 2015; Chambers, Pearson, Kawachi, et al., 2017; Elsley, 2004; Freeman, 2010).

In their “Kids in the City” study of 253 children living in Auckland (NZ), Carroll et al. (2015) reported that school was the most frequently visited destination, followed by shops. Overall, 20% of children’s trips away from home were to visit shops and shopping areas (Carroll, Witten, & Kearns, 2015). By comparison, 15% of trips were to take part in formal organised sport, while 8% of trips were to parks and other recreation spaces (Carroll, Witten, & Kearns, 2015). When asked about their experiences and perceptions of their neighbourhoods, many children from the Kids in the City study reportedly enjoyed spending time at shops,
window shopping and making purchases. Further, children frequently identified local dairies (convenience stores) as a favourite place (Carroll, Witten, & Kearns, 2015). Similarly, findings from an auxiliary Kids’Cam study reported that Wellington children visited food retail outlets an average of 1.9 times per day (Chambers, Pearson, Kawachi, et al., 2017).

As discussed in Chapter One, in 2016, the WHO Commission on Ending Childhood Obesity (ECHO) recommended that member states “implement the Set of Recommendations on the Marketing of Foods and Non-alcoholic Beverages to Children to reduce the exposure of children and adolescents to, and the power of, the marketing of unhealthy foods.” The Commission also recommended that “settings where children and adolescents gather (such as schools and sports facilities or events) and the screen-based offerings they watch or participate in, should be free of marketing of unhealthy foods and sugar-sweetened beverages” (World Health Organization, 2016, p.18).

The findings of this study demonstrate that children gather in the streets and outside shop fronts, and are exposed to food advertising in these settings. There have been repeated calls from the WHO for the restriction of food advertising to children in settings identified as ‘children's places’ (such as school and other institutions designed for their use (World Health Organization, 2012b; World Health Organization, 2016; World Health Organization, 2017). However, public spaces, including streets, fresh food markets and the public areas surrounding shop fronts are noticeably absent from conversations about places where food marketing should be restricted to protect children from its influence. The results of this thesis suggest that children’s exposure to unhealthy food advertising occurs in settings beyond those typically identified as children's settings, and includes those at the intersection of children's and adult's worlds. Further, the findings of this thesis suggest that the broadest interpretation of places where children gather should be employed when developing regulations to restrict children’s exposure to food advertising. This is discussed in more depth in the implications section of this chapter.
Differences in children’s exposure to non-core and core outdoor advertising by ethnicity, school decile, BMI category, and gender

Differences by ethnic group

Assessing children’s overall exposure to outdoor food advertising by ethnic group revealed notable differences in the rates of outdoor advertising exposure between Māori and NZ European children, but few differences between Pacific and NZ European children. For each hour spent in outdoor settings, the overall rate of non-core food advertising exposure among Māori was 1.5 (95%CI 1.0 to 2.2) times that of NZ European participants. Similarly, Māori children were exposed to core advertisements at a rate 1.7 (95%CI 1.2 to 2.5) times greater than that of NZ European children. Māori children were also exposed to fast food advertising at almost double the rate of NZ European children.

Based on the findings of this study, it is unclear why Māori participants would be exposed to greater rates of non-core and core outdoor advertising than their NZ European peers. In the adjusted Poisson regression model, after controlling for school decile stratum, the rate ratio for Māori remained the same. However, the confidence intervals for the rate ratio widened and the difference was no longer statistically significant. This may suggest that school decile stratum (and therefore area level deprivation) accounts for some of the difference in non-core exposure rates between NZ European and Māori children. A possible explanation for these findings is that Māori children may live in neighbourhoods in which outdoor food advertising is more common, discussed further below.

In this study, there were no statistically significant differences in mean rates of non-core and core advertising exposures between Pacific and NZ European participants. However, assessing Pacific participants’ exposure to outdoor food advertising at fresh food markets revealed that Pacific children had higher rates of non-core and core food advertising exposure than NZ European children, with RR of 9.4 (95%CI 0.5 to 168.5) and 5.5 (95%CI 0.2 to 147.7), respectively. It is possible that this difference can be explained by the different amount of time NZ European and Pacific children spent at fresh food markets. Pacific children spent a
greater overall proportion of their outdoor time at fresh food markets (2.7%) than NZ European children (1.0%).

Aside from the difference in exposure rates at fresh food markets, there were no other notable differences observed in advertising exposure rates between Pacific and NZ European participants. While it is possible that differences do exist between the groups, they may not have been observed given the lower number of Pacific children compared to Māori and NZ European included in this study. Further, the sample size calculations used for Kids’Cam were powered to determine differences in overall advertising exposures between Pacific and NZ European children. Therefore, it is likely that this study was not sufficiently powered to detect differences between NZ European and Pacific groups in the subset of image data collected in outdoor settings. This is discussed further in the strengths and limitations section of this chapter.

In New Zealand, there has been no published research assessing ethnic differences in outdoor advertising exposure. However, ethnic differences have been reported in studies of outdoor food advertising in the US (Cassady et al., 2015; Hillier et al., 2009; Isgor et al., 2016; Yancey et al., 2009). As discussed in Chapter Three, collectively, these studies report that majority Hispanic or African American neighbourhoods had a disproportionately greater number and density of unhealthy outdoor food advertisements than majority European neighbourhoods (Hillier et al., 2009; Yancey et al., 2009). These studies suggest that there may be distinct ethnic differences in exposure to outdoor food advertising.

Similar to the US, New Zealand neighbourhoods are patterned by socioeconomic deprivation and ethnicity. Māori are overrepresented in the areas of greatest socioeconomic deprivation (Ministry of Health, 2015). In 2013, 40.9% of Māori lived in the most deprived neighbourhoods (NZDep2013 deciles 9 and 10) compared with 15.3% of non-Māori. Māori are also underrepresented in the least deprived neighbourhoods (NZDep2013 decile 1 and 2) making up just 8.6% of the population compared with 23.3% of non-Māori (Ministry of Health, 2015). Pacific groups are also overrepresented in the areas of greatest socioeconomic deprivation.
deprivation, with 56.5% of Pacific people living in NZDep2006 deciles 9 and 10 (White et al., 2008).

Results of a recent New Zealand survey of food retail outlets reported a higher density of outlets in the areas of high socioeconomic deprivation (NZDep2013 deciles 9 and 10) (Vandevijvere et al., 2016). As the findings of this and previous New Zealand research suggest that outdoor food advertising is primarily found on, or at, retail outlets (Maher et al., 2005; Walton et al., 2009), the higher number of non-core advertising exposures among Māori participants may be partially explained by a higher density of food retail outlets in higher deprivation neighbourhoods in which Māori are overrepresented.

**Differences by school decile stratum**

In this study, there were no observed differences in the overall mean rates of non-core or core advertising exposures between participants from low and medium decile schools, and those from low and high decile schools. However, there were differences in mean non-core exposure rates in the street and fresh food market settings by school decile stratum. In the street setting, mean rates of non-core food advertising exposure were 2.5 (95%CI 1.4 to 4.6) times greater among participants from medium decile than low decile schools. This finding may be reflective of the greater proportion of time children from medium decile schools spent in the street setting compared to children from low decile schools.

Similarly, children from high decile schools had higher mean rates of non-core advertising exposure in the street setting than those from low decile schools. Although this finding was not statistically significant, on average, children from high decile schools had mean rates of non-core advertising exposure that were 1.8 (95%CI 0.8 to 4.1) times higher than those from low decile schools. Compared with children from low decile schools, children from medium decile schools had significantly lower mean rates of non-core advertising exposure at fresh food markets (RR 0.0, 95%CI 0.0 to 0.0).

The mean rates of children’s exposure to core food advertising followed similar patterns to those of non-core exposure, with mean rates of core food advertising exposure in the street and at fresh food markets showing some variation by school
decile strata. Children from medium and high decile schools had higher mean rates of core food advertising exposure (RRs 3.9, 95%CI 0.8 to 18.7 and 2.9, 95%CI 0.7 to 12.3, times higher respectively) in the street setting than those of children from low decile schools. Conversely, at fresh food markets, children from medium and high decile schools had 70% and 30% lower rates of core advertising exposure respectively. Although these differences were not statistically significant, these findings suggest that children from low decile schools were more likely to spend a greater proportion of their overall outdoor time at fresh food markets than those from higher decile schools.

Overall, the findings of this study suggest there are no overall socioeconomic differences in children’s exposure to outdoor food advertising. Results do suggest higher exposure in the street and fresh food markets to non-core and core outdoor food advertising for children who attend medium and high decile schools, that is, those living in medium and low deprivation areas. This is consistent with the results of small–scale research conducted in Australia and New Zealand that suggests that outdoor food advertisements are more numerous in areas of low deprivation (i.e. wealthier areas) (Kelly, Cretikos, et al., 2008; Maher et al., 2005). However, these findings are inconsistent with those of previous research on outdoor food advertising. Research conducted in the US and the UK consistently reports that the number of food advertisements and the amount of advertising space for outdoor food advertisements is greater in areas of high deprivation than in areas of low deprivation (Adams et al., 2011; Cassady et al., 2015; Isgor et al., 2016; Lesser et al., 2013; Yancey et al., 2009).

Although there has been no large scale research on the extent of outdoor advertising by socioeconomic deprivation in New Zealand, one recent national survey (Sushil et al., 2017) has assessed the location and density of food retail environments by neighbourhood deprivation. The density of food retail outlets was highest in areas of high deprivation (Sushil et al., 2017). In the present study, the majority of non-core and core food advertising exposures were from shop front advertisements, likely at food retail outlets. Based on this finding and that of recent research (Sushil et al., 2017; Vandevijvere et al., 2016), a greater number of
exposures to outdoor food advertising may be expected in the areas of highest deprivation. However, it is likely that a larger sample size and a more geographically diverse sample are needed to assess socioeconomic differences in New Zealand children’s exposure to outdoor food advertising.

It is conceivable that socioeconomic differences in overall (non-core and core) outdoor advertising exposures were not observed due to the use of school decile as a proxy measure for socioeconomic deprivation in this study. This is a key limitation of this work and is discussed further in the strengths and limitations section.

**Differences by BMI category**

Children's mean rates of outdoor food advertising exposure varied between those from the different BMI categories. Participants from the obese BMI category were exposed to a mean of 10.8 non-core advertising exposures per hour, a rate 1.7 (95%CI 1.2 to 2.4) times higher than those from the healthy BMI category. Further, children categorised as obese encountered twice (RR 2.2, 95%CI 1.0 to 4.6) as many advertisements for sugary drinks per hour as those in the healthy weight category. Children from the obese category also had a mean rate of core food advertising exposure that was 2.5 (95%CI 1.1 to 5.6) times higher than those in the healthy BMI category.

As outlined in Chapter Three, few studies have assessed the association between obesity and outdoor food advertising. However, one US study of 2589 adults in Los Angeles and Louisiana reported an association between obesity in the resident population and the proportion of total outdoor advertisements for food and beverages (Lesser et al., 2013). Those living in census tracts with a greater proportion of total outdoor advertisements that were for food and beverages had increased odds of being overweight or obese. For every 10% increase in the proportion of food advertisements within a census tract, the odds of being obese increased by 5%, controlling for ethnicity and age (Lesser et al., 2013). However, the authors note that these differences may be attributable to a number of factors including individual dietary preferences, overall advertising exposure, and urban planning e.g. neighbourhood walkability and opportunities for physical activity.
The findings from Lesser et al. (2013) indicate that those who are obese may live in more obesogenic neighbourhoods than those who are a healthy weight.

The results from this thesis also suggest that there may be an association between outdoor food advertising exposure and obesity. However, as this study was cross-sectional and did not take into account other influences on children’s dietary and physical activity behaviours, this finding should be interpreted with caution we do not know the nature of this association. However as discussed in Chapters One and Two, systematic review evidence has consistently reported an association between children’s exposure to food marketing and the development of obesity (Cairns et al., 2009; Cairns et al., 2013; Hastings et al., 2006).

A possible explanation for the higher rates of outdoor food advertising exposure observed among obese children in this study is that children in the obese category spent a greater proportion of their time in shop front settings than those from the healthy weight category (as discussed in Chapter Six). Therefore, it is possible that children in the obese category made more frequent visits to food stores and were consequently exposed to outdoor advertising at shop fronts at a higher rate than their healthy weight peers.

Although differences were observed between children in the healthy and obese BMI groups, this study was not powered to detect differences in advertising exposure by BMI category. Therefore, these results should be interpreted with caution due to the small sample size. Larger studies may be needed to determine the direction and nature of this association as there were only 25 children in the sample classified as obese.

**Gender**

Mean rates of overall non-core outdoor food advertising exposure were similar between male and female participants. Further, mean rates of non-core and core exposures in the street and shop front settings were similar between gender groups. However, male participants’ overall exposure to core advertising was 1.4 (95%CI 1.0 to 1.9) times the mean rate of female participants. This was a statistically significant finding. Male participants were exposed to core food advertising at fresh food markets at a rate 4.7 (95%CI 1.2 to 18.7) times that of
their female peers. Similarly, at fresh food markets, males were exposed to non-core food advertising at 3.0 (95%CI 0.6 to 16.4) times the rate of female participants. However, the latter result was not statistically significant.

**Most frequently advertised non-core food products (product)**

In this research, 89.2% of all outdoor food advertisements were for non-core foods. This finding is consistent with previous research that suggests outdoor advertising is predominantly for non-core foods (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005). For example, observational research conducted in the Wellington region reported that 70% of all food advertisements within a 1km radius of 10 secondary schools were for non-core foods (Maher et al., 2005). Research conducted in Sydney and Wollongong also reported that 80% of the food advertisements surrounding primary schools were for non-core foods (Kelly, Cretikos, et al., 2008). Similarly, between 85% and 92% of outdoor food advertisements within a 500m radius of 30 primary schools in both Ulaanbaatar and Manilla were for non-core foods (Kelly, King, et al., 2015).

However, with the exception of that observed in Manilla, the proportion of non-core outdoor advertising captured in this study was higher than that reported in previous studies (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005). It is possible that this difference results from measuring children's exposure to the outdoor food marketing that they encounter, rather than documenting the presence of outdoor food marketing in their assumed surroundings, such as a radial buffer around schools.

Of the advertisements for non-core foods, children in this study were exposed to advertisements from the fast food; sugary drinks; ice cream and iced confectionery; cookies, cakes, and pastries; and confectionery categories at the highest rates. Previous research on outdoor food advertising has collectively reported that advertisements for sugary drinks (including sugar-sweetened beverages, juices and fruit drinks) are the most numerous in the outdoor environment (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005; Settle et al., 2014). However, children in this study were exposed to fast food advertisements at the highest rate, followed by advertisements for sugary
drinks and juices. Children were exposed to fast food advertising at a mean rate of 4.0 (95%CI 3.8 to 4.3) exposures and sugary drinks and juices at a rate of 1.2 (95%CI 1.1 to 1.4) exposures per hour spent in outdoor settings. However, previous research has reported that, after sugary drinks, fast food advertisements are among the most common outdoor food advertisements, as are advertisements for ice cream (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005; Settle et al., 2014). In the present study, exposures to ice cream occurred at the third highest rates with a mean of 1.1 (95%CI 0.9 to 1.2) exposures per hour spent in outdoor settings.

Advertisements for confectionery (including chocolate) were also among the most common outdoor food advertising exposures recorded in this study. This finding is consistent with that of previous surveys of outdoor food advertising that reported between 3.0% and 9.5% of all advertisements surrounding school were for confectionery (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005).

In this study, exposures to outdoor food advertisements for cookies, cakes, and pastries were less common than those for sweet drinks, fast food and ice cream. Although, reporting the presence of outdoor advertising, rather than exposure to this advertising, Kelly et al. (2008) reported an average of 1.2 and 1.5 advertisements for these sweet snack foods within a 250m and 500m radius of 40 primary schools across Sydney and Wollongong.

Advertisements for snack foods (including chips, crisps, and popcorn) are reportedly common in the outdoor environment (Kelly, Cretikos, et al., 2008; Maher et al., 2005; Settle et al., 2014). However, children in the present study seldom recorded exposures to advertisements for savoury snack foods. A likely explanation for this difference is the use of different criteria to define snack foods. For example, the definition of savoury snack used by Maher et al. (2005) included pies and other bakery goods which, in the present study, would be included in the cookies, cakes and pastries category. Further, the definition of snack food used in the present study also excluded all rice and wheat crackers which were included
in the core food category. The different criteria used to define snack foods limits comparability between studies.

Advertisements for high sugar, low fibre breakfast cereals are reportedly common in other marketing mediums such as television (Cairns et al., 2009; Cairns et al., 2013; Hastings et al., 2006). However, as discussed in Chapter six, children in the current study were seldom exposed to advertising for these cereals. Previous research (Kelly, Cretikos, et al., 2008), has also reported that advertisements for high sugar, low fibre breakfast cereals were uncommon in the outdoor environment.

The findings of this thesis, together with those of previous research, suggest that the methods of documenting food advertising around schools used in previous research may provide a good estimate of the types of food products children are exposed to via outdoor advertising.

An unexpected finding from this study was the lack of advertisements for diet or artificially-sweetened drinks. Although the beverage industry has responded to the growing obesity problem by reformulating products and producing a wider range of sugar-free and artificially-sweetened products, only three outdoor advertisements for diet or artificially-sweetened beverages were captured during this study. Comparatively, there were 68 outdoor advertisements for sugary drinks and juice captured in this study. Therefore, these findings suggest that sugar-sweetened options still dominate the outdoor advertising landscape for non-core drinks. These results are not directly comparable with most of the previous research on outdoor food advertising as diet or artificially-sweetened drinks have commonly been reported alongside sugar-sweetened beverages or soft drinks. However, in their audit of 558 public transit stops across Melbourne, Settle et al. (2014) reported that cold beverages were the most common food product advertised at transit stops and that diet drinks were the most common cold beverage product advertised. Diet drinks were seldom captured in this study.

The high rate of children’s exposure to non-core outdoor food advertising in this study is concerning as systematic review evidence suggests that exposure to food advertising increases liking for and acceptability of the advertised food products.
Further, there is strong evidence that food advertising and promotion influences children’s food purchases and their purchase requests (Cairns et al., 2013), and that products requested by children align with those that are heavily marketed to them (Cairns et al., 2013; Kraak & Pelletier, 1998). Food marketing can also influence children’s nutritional knowledge and their understanding of what constitutes healthy food and a healthy diet (Cairns et al., 2013; Harrison, 2005). The findings of this study suggest that outdoor food advertising overwhelmingly promotes food and beverage products that are high in fat, salt and/or sugar. Further, this study is the first to our knowledge to report on children’s exposure to outdoor food advertising, as previous research has largely reported on its presence in outdoors settings.

The extent and nature of children’s exposure to non-core and core outdoor food advertising on their journeys to or from school (promotion)

To our knowledge, this is the first study to document children’s actual exposure to outdoor food advertising on the journey to or from school. The analysis of children’s exposure to outdoor advertising on the journey to or from school included a subset of the sample. A total of 129 children collected a median of 11.1 minutes of data during each trip or from school.

On the journey to or from school, participants were exposed to an average of 0.7 (95%CI 0.7 to 0.8) non-core food advertisements and 0.1 (95%CI 0.1 to 0.1) core advertisements per trip. Extrapolated over the five day school week, assuming the same travel route, children would see a mean of seven non-core outdoor food advertisements. These results do not include exposures seen in malls, supermarkets, convenience stores or other food retail outlets.

Location of outdoor advertising (place)

As with the overall outdoor results, the majority of non-core advertising exposures occurred in the shop front and street settings. The highest rate of both non-core and core advertisements were recorded in the shop front setting, suggesting that outdoor advertising exposures on the journey to or from school
are largely associated with food retail outlets. As discussed earlier in this chapter, the advertising exposures that occurred at shop fronts in this study were likely at convenience stores and fast food outlets. These findings are consistent with previous Australian and New Zealand research which report that the majority of outdoor food advertisements are associated with food retail outlets (Kelly, King, et al., 2015; Maher et al., 2005; Walton et al., 2009).

Exposures to core food advertising occurred at a mean rate of 0.1 exposures per trip and were most common in the shop front setting. Based on the results of this research, children would encounter an average of one core outdoor advertisement over the course of each school week during the journey to or from school. Further, on the journey to or from school participants were exposed to non-core food advertising at a ratio of 7:1. The low rate of core advertising exposure relative to non-core exposure reported on the journey to or from school is consistent with previous findings on the presence of core outdoor advertising in the areas surrounding New Zealand and Australian schools. For example, Walton et al. (2009) reported an average of 4.5 times as many unhealthy (non-core) as healthy (core) food advertisements within the 2km buffer around four Wellington primary schools. A similar pattern was reported in Australian research within 500m of 40 primary schools in Sydney and Wollongong. In this research, the average density of non-core outdoor food advertisements outnumbered core advertisements at a ratio of 19:1 (Kelly, Cretikos, et al., 2008).

Most studies have focussed on documenting the number and density of outdoor food advertising around schools, rather than estimating children’s exposure to outdoor advertising. To date, only one study has attempted to quantify children’s exposure to outdoor food advertising on the journey to or from school. In their study of the immediate geographical area around four Wellington Primary schools, Walton et al. (2009) estimated that children would encounter an average of 9.3 outdoor food advertisements or food retail outlets on their journey to or from school. However, as exposures to retail food outlets and advertisements were reported together it is unclear how many outdoor advertisements children encountered on the journey to school.
The number of exposures reported by Walton et al. (2009) on the journey to school was considerably higher (9.3 exposures) than those reported in the current research (0.8 exposures per trip). A possible explanation for the differences in exposure rates is that Walton et al. (2009) counted every outdoor food advertisement, and in the current research we did not count every instance of food advertising visible in the image as an exposure. For example, in an image of a shop front displaying multiple signs for a single product, e.g. classic Coca-Cola, our coding rules stipulated that the advertisements be coded only once. An example of this is given in Chapter Five, Figure 13. This rule was developed for Kids'Cam to ensure that our coding was conservative, to ensure that we did not over-exaggerate children's exposure to food marketing. However, it is likely that this approach led to an underestimate of children's exposure to food marketing and outdoor food advertising. A further, possible explanation for this difference is that Walton et al. (2009) estimated children's exposure to outdoor advertising on the journey based on the documented presence of outdoor advertising and an assumed journey route. Therefore, the figure reported by Walton et al. (2009) was not children's actual measured exposure to outdoor food advertising.

**Difference in children’s exposure to non-core and core outdoor advertising on the journey to or from school by ethnicity, school decile, BMI category, and gender**

There were few differences in the mean rates of exposure to non-core advertising on the journey to or from school by each of the demographic variables. On average, participants in the overweight (but not obese) BMI category had non-core advertising rates that were 80% lower (RR 0.2, 95%CI 0.1 to 0.8) than those in the healthy weight category. Although it is unclear why this group had significantly lower rates of exposure to non-core advertising per trip, one possible explanation is the mode of transport used. It is possible that children in the overweight BMI category may have taken public transport or were driven to or from school by car as this would limit the number of exposures captured by the cameras. When children were in buses or cars, the cameras predominantly captured the inside of the vehicle as the cameras sat too low to capture the outside environment. This is discussed further in the strengths and limitations section.
On the journey to or from school, there were no statistically significant differences in non-core or core food advertising exposure by ethnic group or school decile strata. However, this finding should be interpreted with caution. As discussed above, the sample size calculations for the Kids’Cam study were powered to detect differences in total daily marketing exposures between NZ European and Māori, and NZ European and Pacific children. Therefore the small sample size and limited data were likely insufficient to be able to detect differences between demographic groups. A larger sample size may be required to detect such differences if they exist.

**Most frequently advertised non-core food products (product)**

On the journey to or from school, advertisements for fast food, sugary drinks, ice cream, and cookies, cakes and pastries were the most common outdoor advertising exposures. Similar findings have been reported in previous research on the types of food advertised within a 2km radius of primary and secondary schools (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005). In these studies, outdoor food advertisements surrounding schools were primarily for sugar-sweetened and other sweet beverages, sweet and savoury snack foods, fast food and ice-cream. However, in contrast with previous findings in the literature (Kelly, Cretikos, et al., 2008; Maher et al., 2005; Settle et al., 2014), in the current study, children were seldom exposed to advertisements for savoury snack foods.

**Summary of key findings**

Overall, children in this study were exposed to a mean of 8.3 (95%CI 7.9 to 8.7) food advertisements per hour spent in outdoor settings. In all, 7.4 (95%CI 7.0 to 7.8) of these advertising encounters were for non-core food products and 0.8 (95%CI 0.7 to 1.0) exposures per hour were for core food products. This finding suggests that in outdoor settings children were exposed to non-core food advertising at seven times the rate of core food advertising. The findings of this research also suggest that Māori children and children in the obese category may
be exposed to outdoor food advertising (non-core and core) at higher rates than their NZ European and healthy weight peers.

In this study, the majority of non-core and core advertising exposures occurred at shop fronts, on the street, and at fresh food markets. Overall, 89.2% of the outdoor food advertisements were for non-core food products. Of these non-core exposures, advertisements for fast food, sugary drinks, ice cream, cookies, cakes and pastries, and confectionery were the most numerous. Notably, advertisements for diet drinks, snack foods and high sugar, low fibre breakfast cereals were seldom captured in this study.

On the journey to or from school, participants were exposed to a mean of 0.8 outdoor food advertisements per trip, of which a mean of 0.7 were for non-core food advertisements and 0.1 were for core food advertisements. Extrapolated over the five-day school week, assuming the same travel route, children would see a mean of 7 non-core outdoor food advertisements on their journey to or from school per week. The majority outdoor food advertising exposures on the journey to or from school occurred in the shop front and street settings. Again, exposures to outdoor advertisements for fast food; sugary drinks; ice cream; and cookies, cakes, and pastries were the most numerous on the journey to or from school.

**Strengths and limitations of this research**

**Kids’Cam methodology**

A key strength of this research was the method used to assess children’s exposure to outdoor food advertising. The Kids’Cam methodology enabled direct, objective observation of children’s exposure to food marketing in a wide range of settings. The use of wearable cameras enabled unprecedented access to children’s worlds, providing a 136 degree, first-person point-of-view record of participants’ environments, recording their exposures to food marketing as and where they occurred. This is a major advantage of the Kids’Cam methodology. As discussed in Chapter Three, documenting actual exposure to food marketing is difficult in observational studies, particularly in all of the everyday settings in which children spend time, including outdoor settings. Further, the use of this method overcame
many of the limitations inherent in using self- or proxy-report data, and the invasiveness and potential bias of researcher observation (Doherty, Hodges, et al., 2013).

The findings of this research suggest that wearable cameras can be used to effectively quantify the extent and nature of children’s exposure to outdoor food advertising. The results of the Kids’Cam study suggest that wearable cameras can be used to effectively document children’s exposure to food marketing in many settings including the home, school food venues, recreation venues and other public spaces. It was the first study to quantify children’s actual exposure to food marketing in these settings (Signal, Stanley, et al., 2017).

The Kids’Cam study demonstrated that the use of this method is ethical, legal, and acceptable to children and the wider community. The Autographer cameras also provided high-quality images, of which 95% could be coded. Pairing the camera data with GPS data allowed for spatial analyses of observed patterns of exposure in other auxiliary Kids’Cam studies, for example see (Chambers, Pearson, Kawachi, et al., 2017; Chambers, Pearson, Stanley, et al., 2017; Pearson et al., 2017). Further, this research demonstrated the feasibility of manual image coding on a large dataset.

Another important strength of this work was that the areas in which outdoor advertising was captured were not determined by the researcher. Rather, they were settings that the children actually visited and where they spent their time. The method used in this work was able to provide an account of the rate of children’s exposure to outdoor food advertising and the locations of these exposures, rather than describing its presence in the predetermined geographical area assumed to represent children’s neighbourhoods, as in previous research (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015; Maher et al., 2005; Walton et al., 2009).

An additional strength of this work was the 12-month data collection period. Previous studies have collected data on outdoor food advertising over short periods of time, typically less than three months (Kelly, King, et al., 2015; Maher et al., 2005; Settle et al., 2014). However, in this work, the data were collected over
one calendar year to allow for seasonal variation in the amount of time children spend outdoors and variations in outdoor advertising campaigns, especially in a city such as Wellington that has substantial seasonal variation.

Further, we had ethical approval to study the world in which children live, and as such participants were blinded to the food marketing focus of Kids’Cam. As participants were instructed to go about their day as they usually would, and change nothing about their daily routine, it is likely that the collected data closely reflects the lived experience of the participants in this study.

**Using wearable cameras**

Although wearable cameras provide an objective means of collecting rich data on the wearer’s environments, there are drawbacks to their use in research (Barr et al., 2013; Barr et al., 2015; Doherty, Hodges, et al., 2013; Kelly, Doherty, et al., 2011; Kelly et al., 2012). Using wearable cameras is dependent on the participants remembering to wear, turn on and charge the cameras. This was a key limitation of use of wearable cameras in this study as participants were required to wear the camera for all waking hours and the battery life of the camera only lasted until the middle of the day, typically between 12pm-1pm. To overcome this issue, participants were required to change to the second (afternoon) camera at lunchtime. Although they were sent text message reminders twice daily, cameras were not always worn for the full day. Participants were also advised that they could remove the camera at any time if they did not feel comfortable wearing it. They were also advised to remove the camera before playing sport or engaging in vigorous physical activity in which the camera could be damaged or cause injury to the wearer. Participants were also instructed to cover the cameras if it was raining heavily, to prevent water damage. Collectively, it is likely that these actions reduced the amount of data collected during the study period.

Removing or covering the camera due to rain may have particularly reduced the amount of data collected in outdoor settings and likely impacted the amount of data collected on the journey to or from school. However, these issues are difficult to avoid when using wearable cameras and have been noted in previous research (Barr et al., 2013; Barr et al., 2015; Doherty, Hodges, et al., 2013; Kelly, Doherty, et
Another limitation of using wearable cameras for this research was the 7-second interval between image capture. During this interval, it is possible that participants encountered food advertising that was not captured. The results are therefore likely to be an underestimate of the true rates at which children encounter food advertising in outdoor settings.

The extent of children’s exposure to outdoor food advertising on the journey to or from school reported here is likely to be an underestimate of children’s true exposure. The most likely explanation for this is that much of the food advertising on the routes travelled by children was not captured by the wearable camera. For example, when children were driven to or from school in a car or on public transport, the cameras did not always capture the environment outside of the vehicle. The camera was positioned on the children’s chest, which on 12-year-olds often placed the camera below the window opening and therefore too low to capture the outside environment. There were also instances of the children not wearing or turning on their cameras until they got to school in the morning, therefore reducing the number of trips the participants captured over the study period. Collectively, these issues limited the available data for analysis.

Despite these limitations, the use of wearable cameras allowed for the quantification of children’s overall exposure to outdoor food advertising and provided estimates of children’s exposure to this advertising on the journey to or from school. It is the first study to our knowledge to quantify these exposures.

**Exposure and potential exposure**

Throughout this thesis, I have used the term ‘exposure’ to describe all of the outdoor food advertising captured by the wearable cameras. However, it is possible that children did not directly observe the advertising captured in their images as the advertisements may not have been in their line of sight, or their attention may have been elsewhere. Further, as the camera was worn around the neck and sat on the chest, it would be possible for the camera to capture
advertising while the child had their head turned away from it. Therefore, when using the term ‘exposure’, I recognise that each instance of food advertising captured in the images was potential exposure as it cannot be known if the children ‘saw’ and registered each instance of outdoor food advertising the cameras captured. However, as discussed in Chapter Two, advertising’s influential effects do not depend on it being actively recognised or cognitively processed (Bornstein, 1989; Hekkert et al., 2013; Zajonc, 1968). Further, a body of experimental research suggests that exposure to a brand enhances liking for that brand, without active recognition of the exposure (Bornstein, 1989; Hekkert et al., 2013; Olson & Thjømøe, 2003; Stafford & Grimes, 2012). Therefore, it is likely that outdoor food advertising is influential, even if it is not actively recognised and processed.

Sampling
The sampling strategy used in this thesis and for Kids’Cam is another strength of this research as it enabled us to produce estimates of children’s exposure to food marketing by ethnicity. The use of a multi-stage clustered design enabled the inclusion of similar numbers of Māori, Pacific and NZ European children from each of the three school decile strata.

Māori and Pacific children were oversampled in this study relative to the proportion of the total Year 8 student population from these groups. This enabled near equal explanatory power (EEP) (Te Rōpū Rangahau Hauora a Eru Pōmare, 2002) of the results for Māori and Pacific groups. During data analysis, sampling weights were applied to all analyses to account for the over-sampling of Māori and Pacific groups, and the consequent under-sampling of NZ European children, relative to the general population.

As discussed in Chapter Five, the inclusion of equal numbers of Māori and non-Māori participants (EEP) enables the analysis of data in equal depth and breadth for Māori and non-Māori (Te Rōpū Rangahau Hauora a Eru Pōmare, 2002). Further, including equal numbers of Māori, Pacific, and NZ European children was particularly important in this research as obesity is highly patterned by ethnicity, with a disproportionate number of Māori and Pacific children experiencing
overweight or obesity compared with NZ European children (Ministry of Health, 2016). Given food marketing exposure is a significant contributor to obesity, being able to detect differences in food marketing and outdoor food advertising exposure between ethnic groups was a particular focus for Kids’Cam and also this thesis. The findings from Kids’Cam suggest that recruiting equal numbers of children from Māori and NZ European groups is achievable and provides valuable insights about disparities in health outcomes and exposures to risk factors, food marketing exposure in this instance. As such, incorporating the principle of EEP into the study design is a key strength of the Kids’Cam methodology. The use of EEP in health research, in New Zealand and internationally, is essential to investigate the causes of health disparity and to identify ways to reduce and eliminate health inequalities (Te Rōpū Rangahau Hauora a Eru Pōmare, 2002). Owing to the disproportionate burden of poor health outcomes experienced by Māori, the inclusion of EEP in study designs in New Zealand research is essential to ensure that the quality of research produced, and subsequent policy advice, for Māori is of at least the same standard as for NZ Europeans, as required under Te Tiriti o Waitangi (Te Rōpū Rangahau Hauora a Eru Pōmare, 2002).

Although we were able to recruit similar numbers of Māori and NZ European children, it is worth noting that we recruited fewer Pacific children than Māori and NZ European children. In total, Pacific children accounted for only 25% of the Kids’Cam sample. As we recruited children by ethnic group and school decile, we struggled to find high decile schools with sufficient numbers of Pacific children on the Year 8 school roll. As a result, in certain instances, we invited all of the Year 8 Pacific students enrolled at the school. However, we did not always meet recruitment targets for Pacific students.

Overall, the response rate in this study was 38%. It is likely that this relatively low response rate was attributable to the significant burden associated with participating. Children were asked to wear the camera and GPS for all waking hours, to change the camera at lunchtime and charge all equipment overnight. In addition to these practical tasks, by consenting to take part in the study children and their parents were consenting to have all of their daily activities and
environments (including their homes) documented. Therefore, this level of observation had to be acceptable to the child, their parents and those with whom they lived. In light of this, a response rate of 38% was probably acceptable, given the intrusive nature of having most daily activities documented and the burden of wearing and charging the equipment. It is also worth noting that response rates to mail surveys have an average 53% while email surveys have an average response rate of 33% (Shih & Fan, 2009), and both are considerably less burdensome.

It remains possible that those children who did not consent to participate in the study were systematically different from those who did participate. However, as the children were randomly selected and recruited from randomly selected schools with a range of school decile strata and ethnic groups, it is unlikely that these differences would significantly affect the results of this study. Further, as children were blinded to the food marketing focus of this study, it is unlikely that any differences between those that participated and those that did not would significantly bias the results.

Despite the burden associated with participating, we were able to recruit 168 children from a diverse range of school deciles and ethnicities. Further, all of the participants completed data collection and attended the review session.

Among schools, the response rate was 57%. As with the children, there was a burden associated with participating in Kids’Cam for the schools. This included administrative tasks such as collecting consent forms and reporting back to the Kids’Cam team on the number of consenting children, arranging meeting times, ensuring that the children attended, and following up with absent participants. Further, schools were asked to consent to the use of wearable cameras on school grounds, during school hours, as a condition of participation. As the use of wearable cameras in schools is invasive of the privacy of the school community, we anticipated that not all of the schools that we approached would be willing to participate. Further, as the cameras captured images of non-participating students during school hours, the study had to be acceptable to the school community. As discussed in Chapter Four, we informed the school community at least one week prior to participant recruitment. During the Kids’Cam study, there
was only one instance of an objection, by a parent. As a result, we did not conduct the study at that school. Despite the challenges associated with school and participant recruitment, we were able to recruit 16 schools from across the Wellington region.

**Sample size**

The sample size calculation for the Kids’Cam study was powered to detect differences in children’s overall food marketing exposure by ethnic group and school decile strata. Therefore, it is likely that the sample size was underpowered to detect differences between groups in this research. This was particularly pertinent for the journey to or from school data set due to the reduced number of children with data in outdoor settings and particularly, the low number of children with data for the journey to or from school. As such it is likely that a larger sample size was needed to be able to detect differences in exposure rates between children from different ethnic groups and the different school decile strata.

**Deprivation measure**

As discussed earlier in this chapter, this research reported few differences in the mean rates of exposure to outdoor food advertising by school decile stratum. It is possible that no differences in outdoor advertising exposure by school decile stratum exist in this sample of participants. However, as discussed in Chapter Three and earlier in this chapter, international research on outdoor food advertising suggests that there are distinct socioeconomic differences in the placement and content of outdoor advertising by neighbourhood socioeconomic deprivation (Adams et al., 2011; Cassady et al., 2015; Isgor et al., 2016; Kelly, Cretikos, et al., 2008; Lesser et al., 2013; Maher et al., 2005; Settle et al., 2014; Yancey et al., 2009). Therefore, it is possible that differences were not detected due to the use of school decile as a proxy for area-level deprivation. School decile rankings are a measure of the socioeconomic position of a school’s student population relative to other schools nationwide. However, school decile rankings do not account for the socioeconomic mix of students within the school. Therefore, it is possible that wealthy children, living in wealthy areas, may attend low decile (i.e. more deprived) schools. The inverse is also true, whereby poorer children,
living in poorer areas, may attend high decile (i.e. less deprived) schools. This may explain the absence of significant differences in exposure rates between children from the different school decile strata. Further, as schools were grouped into tertiles based on their decile ranking, this may have made any existing differences difficult to identify in the analyses.

NZDep2013 (Atkinson et al., 2014) may have been a more appropriate measure of deprivation for the analyses of socioeconomic differences in this thesis. Further, as the placement of outdoor advertising is likely to vary by neighbourhood, an area-based measure such as NZDep would be preferable to an individual measure of deprivation such as NZiDep (Salmond et al., 2014). While NZDep and NZiDep were collected, as the children were recruited and sampled through schools, the Kids’Cam team agreed that use of school decile in the analysis of socioeconomic differences was the most practical approach for this thesis.

Although this study provided valuable information about children’s exposure to outdoor food advertising, future research would likely benefit from the use of geographic analysis. Such analyses may aid in the disentangling of the relationship between neighbourhood deprivation and outdoor advertising exposure. Such analyses could be used to determine the density of outdoor advertising in children’s neighbourhoods and identify ‘hot spots’ of exposure within the neighbourhood.

**Coding**

**Settings**
The list of settings developed for the coding schedule was comprehensive and encapsulated the many settings in which children spent time during the data collection period. However, some aspects of the coding schedule limit the interpretation of the findings of this research. The definition of sports setting used in this thesis included swimming pools, indoor and outdoor sports stadiums, sports clubrooms as well as sports grounds. Therefore, not only will the advertising exposure captured in the sports setting include sports grounds, it will also likely include advertising in indoor sports settings. This may have resulted in an over-estimate of the rate of exposure to non-core and core food advertising in
the sports setting. However, as this thesis used the Kids’Cam coding schedule, the inclusion of these indoor settings under the sports code was unavoidable. In developing the coding schedule, this compromise was made to keep the list of settings as short as possible. This was necessary to preserve the functionality of the annotation (coding) software for the coders and to facilitate time-efficient coding. Despite this limitation, children’s overall exposure to outdoor food advertising in the sports setting was low, with a rate of 0.3 (95%CI 0.2 to 0.4) non-core and 0.0 core exposures per hour spent in outdoor settings. As such, the possible inclusion of data captured in indoor sports settings is unlikely to have significantly impacted the overall results of the rate of children’s exposure to non-core and core food advertising.

**Coding rules**

To code each image for marketing, at least 50% of a logo or registered trademark was required to be clearly visible in the images. As discussed in Chapter Five, this rule was developed to reduce the risk of misidentification and misclassification of each instance of marketing. It was also introduced to reduce the subjectivity of the coding process and ensure replicability for a coder with little knowledge of New Zealand food brands and products. However, this rule has resulted in an underestimate of the extent of the outdoor advertising to which children in this study were exposed. Examples of instances in which food advertising in the images could not be coded are given in Figure 30 and Figure 31. Figure 30 contains food advertising for Coca-Cola, V energy drink, Monster energy drink and Kāpiti ice cream. However, according to the coding schedule, these instances of advertising would not be coded for as 50% of each logo is not clearly visible due to the poor quality of the image.
A further example of uncodable food advertising is given in Figure 31, which contains advertising for Anchor Milk and Coca-Cola on the dairy shop front. However, due to the angle at which the participant is approaching the dairy, the logos are not clearly visible, and therefore they could not be coded.

A further limitation of the coding schedule was the inclusion of the ‘3+’ function in the coding framework. As discussed in Chapter 5, some of the product categories in the coding schedule could be coded with 1, 2 or 3+, with the latter two codes used when there was more than one instance of food advertising via the same marketing medium, in the same setting, captured in an image. In the analysis, all images coded with 3+ were assumed to represent three exposures to advertising. Therefore, it is impossible to know if those images coded with 3+ contained three or more than three advertising exposures. It is likely that this has resulted in an under-estimate of the true rates of advertising exposure.
As discussed earlier in this chapter and in Chapter Five, we did not count every visible instance of food advertising in the image as an exposure. Instead we counted multiple advertisements for the same product as one exposure. This rule also likely led to an under-estimate of children's rates of advertising exposure in outdoor settings.

**Nutrient profiling**

A further strength of this research is the use of the WHO NPM, as it was specifically designed to restrict unhealthy food marketing to children (World Health Organization, 2015b). In comparison with available New Zealand nutrient profiling models (discussed in Chapter Five), the WHO NPM model provides stricter nutrient cut-off values and identifies five broad food categories that should not be marketed to children. It also provides a clear distinction between foods that can be marketed to children and those that cannot. Further, the WHO NPM can be adapted as needed. For the Kids'Cam study, this was done by adding a category for fast food.
Although the WHO NPM has a category for ready-made and convenience foods and composite dishes, it requires that the nutrient profiles of each fast food product are compared to the nutrient thresholds within the model. However, in the context of the Kids’Cam study, this was not practical because of the time involved as foods had to be classified at the time of image coding. Therefore, all take-away food items from quick service restaurants were included in a single non-core fast food category. This included sushi, and Pita Pit and other take-aways with healthier options available such as Subway and salad bars. Although these restaurants may provide healthier options, it was necessary to include them in the fast food category to facilitate time-efficient coding. As such, the results for fast food likely include some healthier options. However, advertisements for typical fast food chains (e.g. McDonald’s, Pizza Hut, Burger King) vastly outnumbered those for healthier options in the image data.

On the other hand, to limit classification decisions by the coders, some non-core foods were coded as core foods. The core food category included all crackers, instant noodles and full-fat dairy products. Using the WHO NPM almost all products within these food categories would be classified as not permitted (non-core). Under the WHO NPM crackers would only be permitted to be marketed to children (core) if they contained fewer than 40mg of sodium per 100g. Instant noodles would only be permitted if they contained <942.8 kJ, <10g total fat, <4g saturated fat, <10g sugar, and < 400mg of sodium per 100g. However, most crackers and instant noodles would not meet these criteria and would not be permitted to be marketed to children under the WHO model. The inclusion of these foods in the core category in this work is a further limitation of this research as it may underestimate the extent of non-core (not permitted) advertising exposures recorded in this study.

On balance, the methods of nutrient profiling used in this study provided a reasonably accurate means of classifying the identified instances of food marketing. Despite the limitations associated with the WHO NPM's application in this research, it is a robust, comprehensive and readily applicable model for assessing and classifying food marketing. Further, owing to the superiority of the
WHO NPM over the New Zealand Food and Beverage Classification system and the Health Star Rating system, public health and nutrition professionals have recently recommended its use in New Zealand to underpin the ASA’s Children and Young People’s Advertising Code (Ni Mhurchu et al., 2016; Swinburn et al., 2017).

Data analysis

**Chance findings (type I error)**

As with all statistical analyses, it is not possible to rule out the possibility of chance findings in this study. As discussed above, the small sample size limited power for some analyses and multiple comparative analyses performed during data analysis. Therefore, we cannot rule out the possibility that some of the findings of this study may be due to chance. However, some of the statistically significant (p<0.05) findings, such as a higher rate of non-core food advertising exposure among Māori participants and those from the obese BMI category, were anticipated findings and it is unlikely that these are due to chance.

Summary

The key strength of using the Kids’Cam methodology is that enables the measurement of children’s exposure, overcoming the biases inherent in self- or proxy-report data (Doherty, Hodges, et al., 2013). However, as discussed above, the results presented in this thesis are likely to be an underestimate of children’s true exposure due to the conservative nature of our coding rules and coding schedule. Despite the burden associated with participating in Kids’Cam, we were able to recruit 168 children from a diverse range of school deciles and similar numbers of Māori and NZ European children. This enabled near equal explanatory power for each of the three ethnic groups in the study. Further, the use of an adapted version of the WHO NPM provided an accurate means of classifying the identified instances of food marketing. Therefore, despite the limitations discussed in this section, to the best of our knowledge, the Kids’Cam methodology still provided the best evidence, to date, of children’s actual exposure to outdoor food advertising and food marketing.
Implications of this research

The findings from this thesis suggest that outdoor advertising is an important contributor to children’s overall exposure to food marketing. Further, the detailed analysis of children’s exposure to outdoor food advertising performed in this thesis makes an important contribution to the research in this field. It identified the settings in which children were frequently exposed and the types of food advertisements children were most commonly exposed to when outdoors. This research suggests that main streets and shop fronts should be key targets for intervention to reduce children’s exposure to non-core food advertising in outdoor settings.

Outdoor food advertising contributes to the obesogenic environment by reinforcing and promoting brand awareness, and by influencing preferences and social norms (Bhargava & Donthu, 1999; Keller, 2001; Taylor et al., 2006). Further, outdoor advertising is often used as part of multimedia advertising campaigns to facilitate repeated exposure to marketing messages (Bhargava & Donthu, 1999). Although outdoor advertising has received less attention in the literature than other traditional marketing mediums (e.g. television), the findings from this thesis suggest that it is an important medium through which children are exposed to non-core food advertising.

Outdoor advertising is unique as it is embedded in the physical environment and children cannot avoid it in the same manner as advertisements on television or the internet can by changing the channel during advertisements or installing ad blockers on web browsers (Lichtenenthal et al., 2006; Wilson & Till, 2011). Further, as discussed in Chapter Three, children’s defences against advertising’s influence are most advanced for those persuasive attempts that occur through the advertising technique or medium that the child encounters most frequently (Owen et al., 2013). Typically this is more advanced for television compared with other marketing media. Therefore, children’s persuasive knowledge may be context specific and difficult to apply to non-television advertising (Owen et al., 2013).
To engage their cognitive defences against advertising, children must actively recognise when a persuasion attempt is occurring (Harris, Brownell, et al., 2009; Wright et al., 2005). This may be particularly difficult for outdoor advertising as it is embedded in the physical environment and may therefore not be cognitively processed in the same manner as a television commercial that is clearly separated from programme content. Further, Harris et al. (2009) argue that children require additional cognitive defences to defend against the influence of food marketing as foods and beverages are often depicted in advertisements in highly appealing ways.

The high rates of non-core food advertising exposure reported in this research are particularly concerning as children’s exposure to food advertising increases their liking and acceptability of the advertised products (Cairns et al., 2009). Further, children’s purchase requests are strongly associated with the food products or brands that are frequently marketed to them (Kraak & Pelletier, 1998). The weight of the evidence also suggests that food marketing directly influences children’s food intake by acting as a cue for consumption and indirectly influences children’s consumption patterns by shaping their food preferences (Boyland et al., 2016; Cairns et al., 2013; Zimmerman & Shimoga, 2014).

Overall the findings of this thesis suggest that outdoor food advertising may contribute to the development of obesity, alongside other forms of food marketing, by promoting a preference for, and the purchase and consumption of, non-core foods.

**Implications for policy**

This section discusses the policy implications of this research for local and central government and discusses the implications of this research for similar jurisdictions to New Zealand.

**Local government**

To reduce children’s exposure to and the power of food advertising as recommended in the ECHO report (World Health Organization, 2016), the findings
of this study suggest the content and placement of outdoor food advertising in New Zealand should be regulated and restricted in all places where children gather, including residential and city streets, and shop fronts.

In New Zealand, the responsibility for licencing and regulating the placement of outdoor advertising lies with local government. As discussed in Chapter Three, the four city councils within the Wellington region each have different rules and bylaws regulating the construction, size, maintenance and placement of outdoor advertising signs. Although the content of outdoor food advertisements is not currently regulated by local government, councils do regulate the content of some outdoor signs. For example, local government control the placement of signs advertising commercial sex activities and services (Hutt City Council, 2013; Upper Hutt City Council, 2017; Wellington City Council, 2000). Further, the Upper Hutt City Council explicitly states that it does not allow signs that are discriminatory or that advocate discrimination, those that are insulting, offensive or threatening, nor those that encourage or provoke a person to commit an offence (Upper Hutt City Council, 2017). These examples suggest that local government has the power to regulate outdoor advertising content, and have existing bylaws and policies that could be extended to include the regulation of outdoor food advertising.

Local councils in the Wellington region could follow the examples set by São Paulo (Municipality of Sao Paulo, 2006) and Grenoble (City of Grenoble, 2016), and remove outdoor advertising from public places, including shop fronts and streets, the settings where this sample of Wellington children encountered them most frequently. In particular, removing billboards, food advertisements on shop fronts, and other advertising signs along main roads would likely reduce children’s overall food advertising exposure. Further, removing these outdoor food advertisements would likely have the greatest benefit for Māori children who had had the greatest exposure of any ethnic group to non-core outdoor food advertising in this research.

Children in this study encountered an average 0.8 food advertising exposures per trip to or from school. International evidence suggests that outdoor food advertising is often concentrated around schools with the greatest density of food
advertisements found within a 500m of schools (Kelly, Cretikos, et al., 2008; Kelly, King, et al., 2015). As previous research suggests that outdoor advertisements are often concentrated in that area, restricting non-core food advertising within 500m of all schools would also likely reduce children's exposure to outdoor food advertising.

In addition to reducing harm from food advertising, there are multiple co-benefits of removing outdoor advertising from public places. Outdoor advertising is a known traffic hazard and has the potential to contribute to traffic accidents as it distracts from the tasks of driving (New Zealand Transport Agency, 2001). Further, street signs such as sandwich board advertisements clutter the street making it less pedestrian friendly, particularly for the less able, the elderly, and those with pushchairs. There is also concern over the growing commercialisation of public space for private, corporate money-making activities (Baker, 2007). Outdoor advertising reduces places for public expression, notices and art displays (Iveson, 2012). Further, it contributes to the degradation of the physical environment and detracts from heritage or contemporary architecture and natural beauty that might be attractive to residents or tourists (Iveson, 2012). Not only does outdoor food advertising negatively contribute to food preferences and choices, but it also contributes to environmental degradation, and visual pollution (Iveson, 2012). Therefore, there would be many benefits for local residents if councils removed outdoor advertising from public places including streets and shop fronts.
National government

The findings of this research indicate that the Advertising Standards Authority (ASA) Children’s Code for Advertising Food did little to protect children from harmful food advertising in outdoor settings, as almost 90% of the food advertising children were exposed to in outdoor settings were for non-core foods, particularly fast food and sweet beverages. In 2017, the ASA introduced its new Children and Young People’s Advertising Code after it was encouraged to conduct a review of its advertising codes for children by the Ministry of Health. However, as discussed in Chapter Three, the new code is unlikely to reduce children’s exposure to unhealthy food marketing as it remains voluntary; applies to a narrow range of media; lacks enforceability and significant financial penalties for breaches; and uses a nutrient profiling model that is not fit for purpose (Swinburn et al., 2017). Further, the full extent of settings to which it applies is ambiguous and does not appear to apply to outdoor food advertising. This is concerning as children are the population group most susceptible to the persuasive effects of advertising due to their cognitive immaturity and limited cognitive defences against advertising (John, 1999; Kunkel et al., 2004).

According to Consumer Socialization Theory, mass media plays a significant role in influencing children’s consumer-related skills, knowledge and attitudes (John, 1999). However, research suggests that even older children and young adults may lack the ability to recognise the persuasive intent of advertisers and to critically evaluate advertiser’s motives and messages (Carter et al., 2011; Harris, Brownell, et al., 2009; Kunkel et al., 2004; Livingstone & Helsper, 2006; Nairn & Fine, 2008). Therefore, to reduce children’s exposure to unhealthy food marketing, statutory regulations are needed in New Zealand to restrict the types of food products that can be promoted, and the media through which they are promoted. This could be achieved by strengthening the existing Children and Young People’s Advertising Code and making compliance mandatory for all advertisers, with financial penalties for non-compliance. Further, an independent monitoring body is needed to enforce marketing restrictions and monitor the content of food advertising. To significantly reduce children’s exposure to food marketing, the code must adopt a
comprehensive definition of food marketing and apply to all marketing media and a comprehensive range of settings. This includes all settings where children gather including outdoor public places, as the results of this study suggest that children are exposed to non-core advertising at high rates in these settings irrespective of whether they are the intended audience.

To achieve this, the code could employ the PAHO definition of food marketing to children which includes all “marketing directed exclusively to children, marketing with specific appeal to children, and in measured media (television, radio, print, and internet media) marketing to which children are exposed” (Pan American Health Organization, 2011, p.12). Further, the code should be adapted to employ the UNCRC definition of children, that is those below the age of 18 years, as the weight of the evidence suggests that children’s cognitive defenses against advertising may not develop fully until late adolescence or early adulthood (Carter et al., 2011; Kunkel et al., 2004; Nairn & Fine, 2008; Wright et al., 2005).

To restrict the marketing of non-core foods that are HFSS and are inconsistent with the Ministry of Health’s Food and Nutrition Guidelines (Ministry of Health, 2012), an effective, purpose-developed, NPM is required. This research and a comparative study of three possible NPMs (Ni Mhurchu et al., 2016) suggest that the WHO NPM would be the most appropriate to use in New Zealand as it was developed specifically to aid in the restriction of food marketing. Further, the findings of this thesis, Kids’Cam, and recent New Zealand research (Ni Mhurchu et al., 2016) suggest that the WHO NPM can be applied with ease to classifying food marketing. It would also have been a more appropriate NPM to use to regulate New Zealand children’s exposure to food marketing than the Food and Beverage Classification System, the current NPM in use (Ni Mhurchu et al., 2016; Signal, Stanley, et al., 2017).

**International implications**

The findings of this research are likely to be applicable to similar jurisdictions, as outdoor food advertising is a common feature in cities worldwide. The results of this research suggest that children are exposed to food advertising even when they are not the target audience. Many of the international examples of actions to
restrict food marketing, discussed in Chapter Three, focus on the restriction of food advertisements targeted ‘to children’ rather than advertisements ‘to which children are exposed’. This focus assumes that the only advertising children encounter, and are influenced by, is that which is targeted directly to them. In 2017, the Seventieth WHA endorsed the Recommendations made in the ECHO Report Implementation Plan. The implementation plan recommends that member states “adopt and implement effective measures, such as legislation or regulation, to restrict the marketing of food and non-alcoholic beverages to children and thereby reduce the exposure of children and adolescents to such marketing (World Health Organization, 2017, p.10).” The language used in this statement and in many of the regulatory measures introduced internationally (as discussed in Chapter Three) exclusively focuses on food marketing targeted to, directed at, or, with specific appeal to children.

Regulations introduced in the UK, Ireland, and Norway, focus principally on regulating television advertising during children’s broadcast programming or during certain times when the audience includes a significant proportion of children (World Cancer Research Fund International, 2017). However, the results of this thesis, and the wider Kids’Cam study, demonstrate that children’s exposure to food marketing and advertising is not limited to that which is targeted to them during children’s television programming, rather they are exposed to food marketing in most of their everyday environments via multiple marketing media (Signal, Stanley, et al., 2017). Although undoubtedly important, focussing only on food marketing that is specifically targeted to children (through use of techniques that specifically appeal to children) suggests that children are only exposed to, and influenced by, food marketing that is directed specifically to them. This narrow focus on regulating child-targeted food advertising in broadcast media is unlikely to significantly reduce children’s overall exposure to food marketing as it neglects other settings and media through which children are exposed (Swinburn et al., 2017).

The definition of food marketing to children used in the different examples of regulatory action on food marketing to children appears to be highly influential in
determining the marketing mediums and settings to which the regulations apply. As discussed above, one of the broadest existing definitions used to define food marketing to children is that from the PAHO (Pan American Health Organization, 2011). As this definition of food marketing to children includes all marketing to which children are exposed, not just that which is targeted to them, it may be preferential to employ this definition globally when developing food marketing regulations.

The findings of this research also suggest that when developing policies to restrict food marketing to children, these restrictions should apply to all settings and all marketing media.

**Government leadership is needed to address obesity**

Reducing the prevalence of obesity among children requires bold action across all levels of government (World Health Organization, 2012b). As discussed in Chapter Two, the ecological model of health provides a framework for understanding how the environment influences health-related behaviours and provides a framework for improving the environment and context in which health-related behaviours occur (Sallis et al., 2008). At the outer sphere of influence (stylised in Figure 32), public policy and government legislation can influence the creation of supportive food environments for its citizens (World Health Organization, 2012b).

The use of policy measures to create supportive food environments is recognised as being a crucial factor in preventing and reducing childhood obesity as it empowers and supports individuals by making the healthy choice the easy choice (World Health Organization, 2012b). This is particularly poignant as current food environments overwhelmingly promote the consumption of unhealthy foods through their high accessibility, palatability, and low cost, all of which is reinforced by the pervasive marketing of these foods (Roberto et al., 2015). To combat this, the seventieth WHA, in endorsing the ECHO implementation plan, urged member states to take a whole-of-government and whole-of-society approach in the prevention and treatment of obesity (World Health Organization, 2017). There are a number of population-wide policies government can introduce to improve food and physical activity environments, including improved nutrition
labelling, the introduction of food taxes and subsidies, physical activity and food policies in school and other education facilities, and social marketing campaigns (World Health Organization, 2017). Although only one contributor to the development of obesity, there is unequivocal evidence to suggest that food marketing is an important part of the problem and that the restriction of children’s exposure to food marketing must be part of the solution (World Health Organization, 2017).

As discussed earlier, food marketing may contribute to childhood obesity by promoting a preference for EDNP foods, by acting as a powerful cue for food consumption and influencing children’s food preferences and consumption, and requests for products, (Cairns et al., 2013). Further, food marketing may influence children’s knowledge of healthy and unhealthy food products (Cairns et al., 2013). As such, restriction of food marketing to children has repeatedly been identified as a potentially cost-effective, and even cost-saving, population-based approach to reducing childhood obesity (Cecchini et al., 2010; Magnus et al., 2009; Veerman et al., 2009; World Health Organization, 2012b). However, the development of obesity is complex, and there are many direct and indirect influences on children’s

Figure 32 Ecological Model of Health
Source: Mehtälä et al. (2014).
food choices, food intake and physical activity levels, of which food advertising is just one. Therefore, the restriction of food marketing to children should be introduced as part of a comprehensive strategy to reduce childhood obesity. To effectively reduce childhood obesity at a population level, an integrated strategy is needed across all levels of society ranging from individual and community interventions to effect behavioural changes, to government regulations and policies to improve the food environment and support behaviours (World Health Organization, 2012b).

Childhood obesity is a significant threat to public health, internationally and in New Zealand, with significant implications for health and productivity (Ministry of Health, 2016; Ng et al., 2014). As outlined in Chapter Two, obesity is a concern as it increases the risk of developing numerous NCDs, including cardiovascular disease, type 2 diabetes mellitus, and certain cancers (Han et al., 2010). Obesity is also associated with increased morbidity and premature mortality in later life (Reilly & Kelly, 2011). Further, childhood obesity contributes to health inequality in New Zealand as it disproportionately affects Māori and Pacific children, and those children living in the areas of greatest socioeconomic deprivation (Ministry of Health, 2016). Although obesity is a complex problem, restricting children’s exposure to food marketing, including outdoor advertising, is a cost-effective, population-based measure that is likely to positively influence children’s food choices and consumption patterns, and in turn, reduce childhood obesity prevalence and improve health outcomes for New Zealand children.

**Recommendations for future research**

As discussed above, future research would likely benefit from the use of geographic analysis to disentangle the relationship between neighbourhood deprivation and outdoor advertising exposure. This could be undertaken using the existing GPS data collected as part of Kids’Cam.

Further research could also be conducted to assess children’s exposure to all food marketing that children encounter on the journey to or from school. As the analysis presented in this thesis only included data captured in outdoor settings, the data could be further analysed to assess children’s exposure to food marketing
on the journey to or from school, including exposures that occurred in retail outlets. Further, the availability of food on the journey to or from school could be used in combination with the data on food marketing exposures to provide important information about the food environment children encounter on their journeys to or from school.

Finally, this research provides evidence of the need for future research on food marketing to children to focus on all marketing to which children are exposed, not only that which is targeted to them.

**Conclusions**

Obesity poses one of the greatest threats to public health in the twenty-first century (Ng et al., 2014). Although the origins of obesity are multifaceted, the pervasive marketing of EDNP foods is a key modifiable influence on children’s dietary behaviours and childhood obesity (Cairns et al., 2013). The findings of this research suggest that outdoor food advertising is a significant source of children’s exposure to non-core food advertising, irrespective of whether they are the target audience. Further, outdoor food advertising forms an important part of the obesogenic world in which children live as it overwhelmingly promotes non-core food and beverage products over their more nutritious counterparts.

To our knowledge, this is the first study internationally to objectively document and quantify the rate at which children encounter outdoor food advertising. This research suggests that to reduce the extent and power of food advertising, as recommended by the ECHO report (World Health Organization, 2016), urgent action must be taken by local government to remove unhealthy food advertisements from public places, particularly along main roads and at shop fronts. This work extends previous research by providing evidence that children are exposed to unhealthy food advertising, not only in the places where they are known to gather but throughout outdoor environments. Further, this research highlights that the advertising standards codes that regulate the promotion of food to New Zealand children are inadequate. Government regulation of such marketing is urgently required to protect children from harmful food advertising.
Implementing these measures would likely reduce the influence of food advertising on children and should be included as part of a comprehensive strategy to address childhood obesity in New Zealand. Although this study was conducted in New Zealand, the findings of this research are likely relevant for policymakers in other jurisdictions as outdoor advertising is a prominent feature in many cities across the world. Restricting outdoor advertising in cities and urban areas would, as part of a comprehensive strategy, likely improve dietary behaviours, reduce childhood obesity, and improve population health outcomes. Given the extent of the obesity epidemic, restricting unhealthy food marketing is an area for urgent action in New Zealand and globally.
References


desarrollando ideas. (2015). Regulation is not the same as prohibition: The major challenge of regulating the food industry in Peru. Lima: Peru.


effects of food promotion to children. from


vending machines and food and beverage logos in schools and adolescents’ diet and weight status. Public Health Nutrition, 14(8), 1350-1356.


New Zealand Transport Agency (Signs on State Highways) Bylaw 2010 (2010).


Pasch, K. E., & Poulos, N. S. (2013). Outdoor food and beverage advertising: A saturated environment. In J. D. Williams, K. E. Pasch & A. C. Chiquita (Eds.), *Advances in communication research to reduce childhood obesity*. New York: Springer.


Reilly, J. J., & Kelly, J. (2011). Long-term impact of overweight and obesity in childhood and adolescence on morbidity and premature mortality in


State of Vermont. (2012). Vermont Statutes Title 10 Conservation and Development Chapter 21 Tourist Information Services § 495 Other regulations applying to permitted signs.


Appendices

Appendix 1 Information and consent forms for schools, parents, and participants

INFORMATION SHEET FOR PARTICIPATING SCHOOLS

Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not you would like your school to participate. If you allow your school to participate we thank you. If not, we thank you for considering our request.

What is the project about?
This project aims to explore the world children live in, their environment and how it impacts them by documenting what children see and where they go throughout the day - while at home, at school and during most other activities (except personal activities). To directly and objectively capture the environment in which children live, we will be asking approximately 200 Wellington children to wear a GPS recorder, and a camera that hangs around the neck that automatically takes still photographs every 10 seconds. We will also be inviting 60 of the children to take part in a brief interview to determine what they think about their environment. This project is one of the first in the world to use these cutting-edge technologies to explore children’s environments.

This study is funded by the Heath Research Council of New Zealand and led by researchers from the University of Otago, Wellington, in collaboration with researchers from the University of Auckland and Dublin City University, Ireland. It has been approved by the University of Otago Human Ethics Committee (13/220).

What are the benefits of taking part?
We know children have unique knowledge of the world and can provide valuable insights into our understanding of their lives and the environment in which they live and play. This project
provides children with an opportunity to participate in research so that we may learn more about their world, what they think about it, and how it might be improved. To specifically inform Kids’Cam, we conducted two pilot studies, one in 2012 and another in April 2014, to explore the feasibility of using automated cameras and GPS recorders to capture children’s worlds. The children who participated in those studies were keen to take part and said that it was “fun” and “exciting” to be involved in a research project, and that they felt “important” and “trusted”. It was also an opportunity for them to learn about research. In addition, it may also be possible to incorporate the children’s participation into elements of the curriculum – as the school involved in the feasibility study did. We received very positive feedback from the teachers and the school principal we worked with on those projects.

At the completion of the project, we will provide each participating school with a report of the overall findings. The findings from similar research projects have provided schools with information about children’s activities within schools as well as those out-of-school factors which have a potential impact on school life. The findings have, on occasions, been used to inform school policy and practice.

What will the children be asked to do?

We will be inviting between 12 and 36 Year 8 children from your school to participate in this study, from which a total of 6 to 18 consenting children will be selected to participate. It is possible that some consenting children will not be selected to participate. We will be asking those who are selected to take part in the study to wear a camera (as shown in the pictures below) and small GPS recorder for 4 days (from Thursday to Sunday) to take pictures of the things they see and record the places they go during a typical day, including while they are at school.

The project involves two sessions with the children, conducted over one week. The first session (Wednesday) is a one-off group meeting of about 45 minutes. At this meeting all the children involved in the study will meet the researchers, learn about what they will be doing and how to use the equipment, and be briefed on the ethical issues associated with the use of cameras. During this session they will also be given an equipment kit containing their cameras, GPS recorder, chargers, plugboard and an information booklet. On the following Monday, a researcher will collect the equipment so that the information captured can be downloaded.
and stored securely on a University computer. The second session involves meeting with each child individually during that week so that they can review their images, which takes about 20-30 minutes, and to weigh them and measure their height.

We may also be briefly interviewing some children to determine what they think about their environments. A set of general questions we want to ask during the interview has been reviewed by the University of Otago Human Ethics Committee, but because this will be an open discussion they cannot review all of the questions that may come up as a result of the ideas raised during the interview. Notes will be taken during the interview, and it will also be recorded so that it can be analysed later. If the children feel uncomfortable answering any of the questions at any stage, they can choose to stop talking or leave the room. They will be told this at the start of the interview.

At the completion of the second session, each participant will be given a certificate of participation.

As well as asking the children to wear the equipment for 4 days, they will also be asked to charge the equipment each night. So that we can remind the children to wear, recharge and return their equipment kit, we will also ask each child and parent for a contact phone number. The equipment kit and its contents are the property of the University of Otago, Wellington and must be returned to the researchers at the completion of each data collection period. Your school will not be liable for any loss or breakage of equipment.

What will the school be asked to do?
First, we would seek your advice about the potential of undertaking the research at your school and in gaining consent from the school community. We would be available to answer any questions parents and children might have. We would also ask for your assistance with participant recruitment, including distributing and collecting participant and parental consent forms and information sheets in class. We would also require a quiet space somewhere in the school to meet with the children for their two sessions. As this project aims to document children’s environments across a number of everyday settings, including while they are at school, we are asking the school to allow the children to wear the camera and the GPS recorder during the school day, on school grounds.

How will we keep the information safe?
We have several safeguards in place to protect the privacy of the participants and anyone who may appear in the images:

- To ensure control over the use and security of the information, only the researchers involved in the study will have access to the information collected. All researchers must abide by the confidentiality agreements of the Universities involved and the approved ethical protocol. Also, after each child has had the opportunity to view their images and delete those that are personal or sensitive, they will have no further access to the information they have collected. The data collected then becomes the property of the University of Otago, Wellington.
• In any published material, we will blur out the faces of anyone who is captured in the pictures and may be recognisable, including all staff and other students and any signage or other identifying features that would reveal which school the child attended or their home.
• The collected data will be stored on a secure server at the University of Otago, Wellington. Only members of the research team have access to this server. At the end of the project the recordings of the interview will be destroyed. The typed copies of the interview, the images and all other information collected will be kept in secure storage for five years and then destroyed (as per the requirements of the approved ethical protocol).
• The camera only takes still images (every 10 seconds). There is no audio recording. We are only interested in children’s everyday surroundings not the people captured in the images.

If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

You may withdraw your school from participating in the project at any time up until the data is analysed.

**What will we do with the information?**
The results of the project may be published and will be available in the University of Otago Library (Wellington). Any information published will have all identifying details, for example the name of your school and the names of the child participants removed. As noted previously, upon completion of the project you will be provided with a copy of the results.

If you have any questions about our project either now or in the future, please feel free to contact:

**Assoc. Prof. Louise Signal**  
Department of Public Health  
University of Otago, Wellington  
Email: louise.signal@otago.ac.nz  
Phone: 021 0324720

**Dr. Moira Smith**  
Department of Public Health  
University of Otago, Wellington  
Email: moira.smith@otago.ac.nz  
Phone: 021 0851 3535

This study has been approved by the University of Otago Human Ethics Committee (Ref.13/220). If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Kids’Cam: Viewing Young People’s Environments

CONSENT FORM FOR PARTICIPATING SCHOOLS

I have read the Information Sheet concerning this project and understand the purpose and aims of this study and what will be asked of the school. All my questions have been answered to my satisfaction. I recognise that I can ask for further information at any stage.

I acknowledge that:

1. The schools’ involvement in this study is entirely voluntary.

2. This study aims to explore the world children live in, their environment and how it impacts them by documenting what children see and where they go throughout the day.

3. Our school can withdraw from this study at any time up until the data has been analysed.

4. I understand that not all the consenting children will be selected to participate.

5. Student participants will be using the cameras and GPS devices during school time, on school grounds and in other contexts.

6. The equipment kit, including the cameras and GPS devices are the property of the University of Otago, Wellington and will be returned to the research team following data collection.

7. Members of the research team will be meeting with the participants on school grounds, during school hours.

8. The results of the project, including images, and quotes from interviews may be published in journals, talked about at conferences, and will be available in the University of Otago Library (Wellington). Any information published will have all identifying details, for example your school name, and the names of staff and students removed. The camera will capture staff and students in the pictures it takes, but any identifiable faces will be blurred out in any photographs used subsequently in any publications from the study to protect the privacy of those who appear in the images.

9. Upon completion of the project, a copy of the results of the study can be provided if we would like them. ☐ Yes ☐ No
10. To thank them for their participation, participants will receive a certificate of participation, at the completion of the project.

I agree for our school to participate in this study

Facilitating Teacher

[Signature]
Date

School Principal

[Signature]
Date

This study has been reviewed and approved by the University of Otago Human Ethics Committee Ethics Approval (Ref. 13/220). If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Thank you for showing an interest in this project. Please read this information sheet carefully before deciding whether or not you would like your child to participate. If you allow them to participate we thank you. If you decide that you do not want your child to take part there will be no disadvantage to you or your child and we thank you for considering our request.

What is the project about?
We know the world that young people live in impacts their health but we do not have a comprehensive picture of young people’s environments. This project aims to explore the world children live in, their environment and how it impacts them. To do this, we will be asking approximately 200 young people from the Wellington region to wear a GPS device, and a camera that hangs around the neck that automatically takes still photographs every 10 seconds. We will also be inviting 60 of the children to take part in a brief interview to determine what they think about their environment. This project is one of the first in the world to use these cutting-edge technologies to explore young people’s environments.

Your child has been randomly selected, along with several other children from their school, to be invited to take part in this project. We would like 6 children from your child’s school to participate. Please note, it is possible that even though you and your child agree to take part, your child may not be selected in the final participating group.

This study is funded by the Health Research Council of New Zealand and led by researchers from the University of Otago, Wellington, in collaboration with researchers from the University of Auckland and Dublin City University, Ireland. It has been approved by the University of Otago Human Ethics Committee (Ref. 13/220).

What are the benefits of taking part?
This project provides children with an opportunity to participate in research so that we may learn about their world, what they think about it, and how it might be improved, from them. Two smaller studies were conducted in 2012 and April 2014 to
inform Kids’Cam. These studies explored the feasibility of using automated cameras and GPS devices to capture children’s worlds. The children who participated in those studies were keen to take part and at their completion said that it was “fun” and “exciting”, and that it made them feel “important” and “trusted” to be involved in a research project. It was also an opportunity for them to learn about research.

What type of participants are being sought?
The participants being sought for this study are intermediate school-aged young people in Year 8 who wish, and have consented, to participate. Your child’s school has agreed to be involved in the study, and we have invited some Year 8 students from the school.

What will participants be asked to do?
If your child takes part in this project, they will be asked to wear a small camera and a GPS device for 4 days to take pictures of the things they see and record the places they go during a typical day. They will not be asked to change their behaviour or places they visit during the study. The project involves two sessions at school, conducted over one week. In the first session (which takes about 45 minutes and is held on a Wednesday) all the participants will be fully briefed about the project, given instructions on what to do and learn how to use the equipment. They will be given an equipment kit containing two cameras and a GPS device, chargers, plug board, and instruction booklet and information card. Participants will then be asked to wear a camera and GPS device for 4 full days (Thursday – Sunday inclusive) while at home, at school and during most other activities. They will be advised to take them off before doing vigorous sporting activities or personal activities (such as getting changed, and toileting). The camera only takes still images. There is no audio recording.

The camera is relatively discrete, but it may generate some interest from members of the public. If your child takes part in the study they will be provided with information cards that they can give to interested members of the public, if approached and asked about the device. These cards will outline the nature of the study and prompt interested people to contact the researchers at the University of Otago if they have any further questions about the study.

On the following Monday, a researcher will collect the equipment at school so that the information captured can be downloaded and stored securely on a University computer. The second session involves meeting with your child individually sometime during that week at school so they can review their images, and to weigh and measure their height. This session takes about 20-30 minutes.
If your child has been invited to be interviewed, the interview will also be conducted at this session and will take about 15-20 minutes. A set of general questions we want to ask during the interview has been reviewed by the University of Otago Human Ethics Committee, but because this will be an open discussion they cannot review all of the questions that may come up as a result of the ideas raised during the interview. Notes will be taken during the interview, and it will also be audio taped so that it can be analysed later. If your child feels uncomfortable answering any of the questions at any stage, they can choose to stop talking or leave the room. They will be told this at the start of the interview.

As well as asking participants to wear the equipment for 4 days, they will also be asked to charge it each night. So that we can remind the participants to wear, recharge and return their equipment kit, we will ask you for a contact phone number. The equipment kits are the property of the University of Otago, Wellington and must be returned to the researchers. The participants, caregivers or the school will not be liable for any equipment loss or damage.

Along with the consent form, we have included a brief questionnaire for you to complete. This questionnaire will provide demographic information so that we can describe the group of participants. It will not be used to describe your child individually.

**How will we keep the information safe?**

It is important that we keep the information the young people gather secure and protect their privacy and that of anyone who may appear in the images.

To ensure control over the use and security of the information, only the researchers involved in the study will have access to the information collected. All researchers must abide by the confidentiality agreements of the Universities involved and the approved ethical protocol. Also, after your child has had the opportunity to view their images and delete those that are personal or sensitive, they will have no further access to the information they have collected. The data then becomes the property of the University of Otago, Wellington.

In any published material, we will blur out the faces of anyone who is captured in the pictures and may be recognisable, including all school staff and other students as well as any signage or other identifying features that would reveal which school your child attended or your home.

Any information that is provided to us including: the pictures taken by the camera, the interview recordings, and that from the demographic questionnaire, will be stored on a secure server at the University of Otago, Wellington. Only members of the research
team have access to this server. At the end of the project the interview recording will be destroyed. The typed copies of the interview, the images and all other information collected will be kept in secure storage for five years and then destroyed (as per the requirements of the approved ethical protocol).

You may withdraw your child from participating in the project at any time and without any disadvantage. You may also withdraw any information that you or your child have already provided, up until the analysis of this information begins.

If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.

**What will we do with the information?**
The results of the project may be published and will be available in the University of Otago Library (Wellington), any published information will have all identifying details, for example your child’s name and school, removed. You are most welcome to request a copy of the results of the project should you wish.

**Do you have any Questions?**
If you or your child have any questions about our project either now or in the future, please feel free to contact:

Assoc. Prof. Louise Signal
Department of Public Health
University of Otago, Wellington
Email: louise.signal@otago.ac.nz
Phone: 021 0324720

Dr. Moira Smith
Department of Public Health
University of Otago, Wellington
Email: moira.smith@otago.ac.nz
Phone: 021 0851 3535

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Kids'Cam: Viewing Young People’s Environments

CONSENT FORM FOR PARENTS / CAREGIVERS OF PARTICIPANTS

I have read the Information Sheet concerning this project and understand what it is about. All my questions have been answered to my satisfaction. I understand that I can ask for further information at any stage.

I know that:-

1. My child’s participation in the project is entirely voluntary.

2. This study is looking at the world children live in, their environment and how it impacts them.

3. I am free to remove my child from the project at any time without any disadvantage.

4. I understand that my child may not be selected in the final participating group of children from their school.

5. My child will be asked to wear a camera and GPS device for 4 days and will be asked to recharge the equipment every night for 4 days.

6. The camera will be taking pictures of my child’s environment at home, at school and during most other activities.

7. My child will not be asked to change their behaviour or the places they visit during the study.

8. My child will be briefed on situations where they will need to remove the camera and turn it off, to protect their privacy and the privacy of those around them.

9. My child can take off the camera and GPS device at any time if they do not feel comfortable.

10. My child may be interviewed about what they think about their environment.
11. If my child is interviewed, the research team knows the general areas that they want to cover but the exact questions, which will be asked, have not been determined in advance, and will depend on the ideas my child brings up.

12. If my child is interviewed, they do not have to answer any of the interview questions if they don’t want to, and they can leave the interview at any time.

13. My child’s height and weight will be measured.

14. I will be asked to provide a contact phone number to remind my child to wear, recharge and return the equipment.

15. My child will be provided with information cards about the project that can be given to members of the public in the event they are approached, and asked why they are wearing a camera. These cards will have the contact details of the researchers at the University of Otago, and will encourage interested parties to contact the researchers for further information about the project.

16. After my child has reviewed the photographs they have taken and removed any images they do not want the researcher to see, they will no longer have access to the photographs they have taken; they will become the property of the research team. This is to ensure that my child’s privacy and the privacy of anyone that appears in the pictures are protected, and to ensure that the images do not enter the public domain.

17. The equipment kit, including the cameras and GPS device, are the property of the University of Otago, Wellington, and will be collected by the researcher after my child has worn the devices for 4 days. The participants, caregivers or the school will not be liable for any equipment loss or damage.

18. Typed copies of the interview recording, the photographs and other information will be kept in secure storage for at least five years and then destroyed.

19. The results of the project, including images from the camera, and quotes from interviews may be published in journals, talked about at conferences, and will be available in the University of Otago Library (Wellington). Any information published will have all identifying details, for example my child’s name, removed.
20. I would be happy to be contacted within the next 18 months about the possibility of my child participating in other aspects of this research project? Saying yes to this question would not commit them to participating; it just means that we can contact you to ask.

- Yes I am happy to be contacted again
- No, don’t contact me again

I would like to receive a copy of the key findings of this study

- Yes
- No

I agree for ................................................................. to take part in this project

(Child’s name)

................................................................. .................................................................

(Signature of parent/guardian) (Date)
Kids’Cam: Viewing Young People’s Environments

INFORMATION SHEET FOR PARTICIPANTS

Hi, we are doing a study about all the things young people see in their everyday surroundings. Thank you for showing an interest in this project. Before you decide if you want to take part in this study please read this information sheet carefully because it is important that you understand why we are doing this study and what you might be asked to do. You do not have to take part in this study. If you decide to take part, talk to your parents or caregiver. If they agree that you can participate, please ask your parent or caregiver to complete the parent’s consent form that says it’s ok for you to be involved in the study and bring it back to school.

What is this project about?
Our project aims to learn about the world young people live in - the things they see in the different places they go, during a normal day. For example, we want to see what you see on the way to school, while you’re at home or at school, and what you see when you’re out in your community. To do this, we will be asking participants to wear a small camera that hangs around their neck and automatically takes a picture every 10 seconds throughout the day. Participants will also be asked to wear a small GPS device which will record where they go.

You, and several of your Year 8 classmates, have been invited to take part in this project. It is possible that we will have more children who want to participate than we need from your school. That means that even though you may agree to take part in the project, there is a chance that you may not be included in the final group of children who do take part.

This study is funded by the Health Research Council of New Zealand and is being run by researchers from the University of Otago in Wellington, as well as the University of Auckland and Dublin City University, Ireland.
Why have you been invited to take part?
Your school has agreed to be involved in this project. We are looking for approximately 200 Wellington students to take part in our study. We have invited some Year 8 students from your school, including you, to consider participating. You do not have to take part in this study if you do not want to.

If you take part in the study what will you be asked to do?
To take part in this study you will need to be able to attend two meetings which will be held at your school during one week.

You will be asked to wear a camera and GPS device for 4 days during all of your normal daily activities, except for during some physical activities and any personal activities like getting changed, or going to the toilet etc. You will have to recharge the camera and GPS device overnight, each night, for 4 days.

You can take off the camera and GPS device any time you don’t want to wear it.

At the first meeting, which will be about 45 minutes long and held on a Wednesday, all those who are participating will meet the researchers, learn about the study and learn how to use the camera and GPS device. You will be given an equipment kit containing two cameras, GPS device, plugbaord and chargers. Starting from the next morning, you will be asked to wear a camera and GPS device on Thursday, Friday, Saturday and Sunday. On the following Monday, you will bring the devices back to school and the researcher will collect them and download all of the information you have collected onto a secure computer.

Later that week, we will come to the school for the other meeting, which will last about 45 minutes. You will be able have a look at all the images the camera recorded and delete any that you do not want the researcher to see, and measure your height and weight. We will also be inviting some of the participants to answer some questions about what they think about their everyday surroundings.

Can I change my mind and withdraw from the study?
If you decide to be part of the study, you can stop at any time and you don’t have to give us a reason.
What data or information will be collected and how will you use it?
The pictures taken will be used to show us the sorts of things you see in your everyday surroundings.

To keep all of the pictures taken and other information you collect safe and private, only the researchers will have access to the information you collect. Once you have looked at the pictures from the camera and deleted the ones you don’t want anyone else to see, the researchers will look after them and all the other information you have collected. The researchers must keep everything confidential and they are not allowed to share the information with anyone else.

All your information will be kept on a secure computer protected with a password.

If any of the photos taken have people in them, for example your family and friends, or teachers, and we wish to use the photos in our reports, we will blur out their faces to protect their privacy. We will also blur out any signage or other features that would identify your school or home.

The camera only takes photographs. It doesn’t record video, or your conversations.

If you have been invited to be interviewed, there will be a tape recorder on while we are talking, and we will write down some of the things you say. If you don’t want to answer some of the questions, that’s OK too, you don’t have to answer any question that you don’t want to.

After the interview, we will type out the words on the recording and after we have finished writing the report we will delete the recordings. The typed out copies of the interview will only be seen by the researchers at Otago University. After we have finished writing up the study, the data collected and the typed copies of the interview will be stored securely for at least five years and then destroyed.

The results of this study will be used to help us write a report for the University and may be published in reports and journals, and might be talked about at conferences. We might publish some of your photographs and write about some of the things you have talked about during the
discussion, but we will not use your name, or any of the information you give us to identify you in any way.

**What if I have any questions?**
If you have any questions now, during or after the study you can talk to us, on your own or with a parent or caregiver, please feel free to contact:

Louise Signal  
Department of Public Health  
University of Otago, Wellington  
Email: louise.signal@otago.ac.nz  
Phone: 04 9186040

Moira Smith  
Department of Public Health  
University of Otago, Wellington  
Email: moira.smith@otago.ac.nz  
Phone: 021 0851 3535

This study has been reviewed and approved by the University of Otago Human Ethics Committee Ethics Approval (Ref. 13/220). If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Kids’Cam: Viewing Young People’s Environments

CONSENT FORM FOR PARTICIPANTS

I have been told about this study and understand what it is about.

I know that:

1. I don't have to take part in this research project if I don't want to.

2. Nothing will happen to me if I choose not to take part in the project.

3. I understand that I may not be included in the final group of participating children from my school.

4. The researchers will be asking me to wear a camera and a GPS device for 4 days during all of my normal daily activities, except for during private things like getting changed and going to the toilet. They might also be interviewing me about what I think about my everyday surroundings and the world I live in.

5. I will wear the camera and GPS device to the best of my ability for 4 days.

6. I can take off the camera and GPS device any time I don't want to wear it.

7. I will be able to delete any pictures that I don't want anyone else to see. But after I've looked through all of the pictures and deleted the ones I don't want anyone to see, I won't be able to access the pictures again. They will be given to the research team to look after.
8. The researchers will measure my height and weight.

9. The researchers will contact me or my parents to remind me to wear and recharge the camera and GPS device and to return them.

10. The equipment kit, including the cameras and GPS device, belong to the University of Otago and must be given back to the researcher after I have worn them for 4 days.

11. During the interview there are no right or wrong answers and I don’t have to answer any questions if I don’t want to.

12. The researcher team will write up the results from this study for University work. The results may also be written up in journals and talked about at conferences.

13. The research team will write about some of the pictures I took and some of the things I talked about, but won’t use my name or anything that might identify me in any published material.

14. The recording of the interview and the written copy of the words on the recording will only been seen by the researchers at Otago University.

15. If I have any questions about any part of the study I can talk to the researchers about them.

16. I would be okay to be contacted again to see if I would like to do more research on this project. Saying yes does not mean that you would have to do it, it just means that you are okay with us asking you about doing more.

☐ Yes I am happy to be contacted again

☐ No, don’t contact me again
I agree to take part in the study.

Signed ........................................ Date ........................................

Thank you!

This study has been reviewed and approved by the University of Otago Human Ethics Committee Ethics Approval (Ref. 13/220). If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix 2 Participant Demographic Information Sheet

Kids’Cam Participant Demographic Information Sheet

1. Is your child?
   - Male
   - Female

2. What is your child’s date of birth? _________________

3. Which ethnic group does your child belong to? (Mark all the spaces that apply)
   - New Zealand European
   - Māori
   - Samoan
   - Cook Island Māori
   - Tongan
   - Niuean
   - Chinese
   - Indian
   - Other such as DUTCH, JAPANESE, TOKELAUAN. Please state: ____________________________

4. What is your child’s home address?
   ________________________________
   ________________________________
   ________________________________
6. In the last 12 months have you personally been forced to buy cheaper food so that you could pay for other things you need?  
   Yes / No

   In the last 12 months have you personally been out of paid work at any time for more than one month?  
   *No if retired and for full-time caregivers/homemakers  
   Yes / No

   In the 12 months ending today did you yourself receive payments from any of these three benefits: Jobseeker Support, Sole Parent Support or Supported Living Payment?  
   Yes / No

   In the last 12 months have you personally put up feeling cold to save heating costs?  
   Yes / No

   In the last 12 months have you personally made use of special food grants or food banks because you did not have enough money for food?  
   Yes / No

   In the last 12 months have you personally continued wearing shoes with holes because you could not afford replacements?  
   Yes / No

   In the last 12 months have you personally gone without fresh fruit and vegetables, often, so that you could pay for other things you needed?  
   Yes / No

   In the last 12 months have you personally received help in the form of clothes or money from a community organisation (like the Salvation Army?)  
   Yes / No

Thank you!

This study has been reviewed and approved by the University of Otago Human Ethics Committee Ethics Approval (Ref. 13/220). If you have any concerns about the ethical conduct of the research you may contact the Committee through the Human Ethics Committee Administrator (ph 03 479 8256). Any issues you raise will be treated in confidence and investigated and you will be informed of the outcome.
Appendix 3 Kids’Cam Protocol Handbook

KIDS’CAM PROTOCOL HANDBOOK
School recruitment protocol

1. Contact principal to discuss and arrange a meeting time with them and a facilitating teacher
2. Email information sheets and consent forms to school principal; provide support material and/or arrange meeting times to assist with informing the school community
3. Arrange:
   a. a time to brief the teachers and invite the children on the Tuesday prior to briefing
   b. Arrange for a time for the briefing session.
4. Commence data collection

Points to raise at meeting with principal:

- Know that children’s environments and the world they live in impact their health
- Know that children have valuable insights into their lives
- We have yet to capture those insights in a comprehensive way
- HRC funding
- School randomly selected based on ethnicity
- Describe the study; talk about the pilot studies and feedback from the participants and teachers; participant selection; show the equipment box
- Examples of what the data will be used for: physical activity, active transport, use of green spaces; alcohol and gambling exposure; food; where children go
- Children randomly selected from Year 8 list; over inviting; require XX from this school
- Inform them that we will be able to provide them with findings
- Go through risk management issues; make sure that we convey that we have sought legal and ethical advice throughout
- Discuss that we will work with the school to schedule data collection during times that will be the least disruptive to the school day and the children’s learning; individual class time the best, rather than lunchtime or group learning
- Talk about how important it is to inform the school community, ask how best to do that and offer whatever assistance we can
- Ask for the things we need the school to do for us: place to work, distribution of information sheets, Year 8 student list – also say that we will get back to
them with the 12 children we have invited so that they can assess them for exclusion criteria

- Arrange times for:
  - Informing the school community
  - Our deadline for Year 8 student list
  - Drop-off of participant recruitment pack
  - Briefing and interview sessions

Make sure principal and facilitating teacher have signed school consent form before proceeding.
Inviting children and teachers protocol

Take with you:

- Invited children / participant list x 2 (one for the school to use)
- Invitation packs:
  - Put in a plastic sleeve:
    - Information sheet for participants
    - Consent forms for participants
    - Information sheet for parents
    - Consent form for parents
  - Put name of child selected on sticker on front of plastic sleeve
- Equipment box with instruction sheet for demonstration

Children:

Introduce yourselves – we are researchers from the University of Otago; what do researchers do?

We have come to your school today to invite you all to take part in a really cool research project called Kids’Cam.

We are interested in learning about the world you live in and how it impacts your health so we’d like to find out more about the things you see and the places you go during the day.

To do that we have some really cool pieces of equipment – a camera and a recorder that talks to the satellite to tell us where you have been.

They are worn around your neck and the camera takes pictures every 10 sec. We can then look back at the photos and analyse them to see what you see in your day.

What we’d like you to do if you are interested is to wear the camera and GPS recorder for four days to collect pictures for us that we can later analyse. You won’t be able to keep the pictures but you will get a chance to look at them. We might also ask some of you to answer some questions about your pictures.

So we have some invitations here for you to read. You would also need your parents’ permission and there is information in here for them too.

You don’t have to take part if you don’t want to – it is okay to say no.
We need XX children from your school to take part. If we have more than we need to take part, we will take your names out of a hat. So it may be that not all of you will take part.

Go through their invitation packs; any questions please call one of us.

**Teachers:**

Introduce yourselves

Explain the project:

- Wanting to learn about children’s worlds and how it impact health; make sure they know we are not interested in their teaching
- Show the camera and GPS recorder to the teachers; how they are worn
- Explain that the children wear the camera and GPS for four days, including Thursday and Friday
- Need to change the camera at lunchtime
- Explain that the camera doesn’t record sound or video

We need the children for:

- 30 mins next Wednesday – all together (for briefing)
- 30 mins the following week (Tuesday or Wednesday) – individually (for review/interview)
  
  We would like them to:

- Check on consent returns on XXXX
- Let us know who is consenting and who isn’t – select a facilitating teacher to correspond with
- Remind the children to replace their cameras at lunchtime on Thursday and Friday
- Remind the children on Friday to bring their cameras to school on Monday
Briefing Session Protocol

Take with you to the briefing:

- Invited children / participant list
- Laptop
- Equipment kits
- Box with spare equipment
- Spare information sheets and consent forms
- Wear an Autographer!

Once you are at the school:

Before you start the briefing make sure that all consent forms / demographic questionnaires are signed and collected.

Assign participant numbers on invited children / participant list sheet:
cycle#school#order in list e.g. 3004007

Assign a box number to a participant and label the box accordingly.

Briefing procedure:

1. Thank everyone for agreeing to take part in the Kids’Cam project
2. Introduce yourself and get the kids to introduce themselves
3. Have you all read the information sheet and consent form? Does everyone understand what the project is about?
4. Explain the project: We are interested in finding out more about your everyday surroundings and the world you live in so we would like to document what you see and where you go throughout the day including what you see when you’re at home, at school and during most other daily activities. Even if you think it is boring and uninteresting we want to know. So do this we are going to ask you to wear a camera like the one I am wearing and GPS device for the next four days: Thursday, Friday, Saturday, and Sunday. Show sample of Autographer data
   a. This is the sort of images the Autographer collects.
   b. As you can see the Autographer will take pictures of everything and everyone around you while you are wearing it.
5. Make sure everyone is happy so far
6. Hand out instruction booklets
7. Discussion of Ethical Issues
We want you to wear the equipment during most of your normal daily activities. We don’t want you to change anything you do during the day, just go about your day as you normally would if you were not wearing the camera. Even if you think what you doing or where you is boring.

But there are a number of places or times where you cannot wear your camera

Turn to page 5 in the instruction book

Walk through each point with the children

You can turn off or take off the Autographer anytime you don’t feel comfortable wearing it.

You will need to turn off or take off the Autographer in the following places:

- Before going to the bathroom or getting changed.
- In public bathrooms and changing rooms and showers (including those at school, sports clubs, and swimming pools).
- Public swimming pools.
- Anytime you are around anyone that is not fully clothed.
- In hospitals, hospices, and doctors’ offices.
- In shops, supermarkets and other buildings where there is a notice or sign that says you can’t take photos.
- If on a marae, check with the person in charge to make sure it is okay to wear the camera.
- If someone asks you to take it off.
- Before playing contact sports (like rugby). You shouldn’t need to take it off at lunchtime or break times, unless you are doing something you think might damage the Autographer.
- Before you go swimming. The Autographer is not waterproof.
- If it is raining really heavily and you think it might get wet while you are outside.

BUT PLEASE REMEMBER TO PUT IT BACK ON!

Don’t worry if you forget to take it off - you will be the first person to see the photos and you will be able to delete anything you don’t want us to see.
Dealing with attention

It is noticeable and you will probably be asked about it. Most people will be fine, some will ask you questions and if they do this is what you say if there are any problems turn it off or ask them to call us.

If people ask you what it is you say:

“I am part of a study run by the University of Otago that is looking at my environments. I am wearing a camera that takes a picture every 10 seconds. But the camera is not deliberately taking pictures of individual people or places.”

If at any time during the project you don’t want to be part of the study anymore, that’s fine, either you or your parent just need to contact a member of the research team and let us know.

Instructions on how to use the equipment

Ask them to take out the GPS and leave the box on the floor

8. GPS device
   a. Explain what it does – maps where you go, we can draw a map; uses the satellite to record; doesn’t work inside buildings; only when you are outside; able to map your photos with where you go
   b. Go through booklet instructions

Put away the GPS and pick up a camera

9. Autographer
   a. Sensors – temperature, movement, light, and colour
   b. Go through booklet instructions
   c. Explain privacy dial
   d. Get them to put it on – clip and around the neck – keeps it safe and stops it moving
   e. Needs to be worn on top of your clothing, so that we can see what you see.
   f. Change the Autographer at lunchtime – battery issues

10. Show the rest of the kit – chargers and plug board – how to recharge

11. Put everything back in the kits

12. Answer questions

13. Tell them about reminder texts
   a. 7am and 7pm Thursday, each day
b. 1pm Saturday and Sunday  
c. 7am Monday  

14. Confirm next visit – *when you will have the chance to look through their photos and we will be interviewing some of you about what in there is in their photos.*  
15. Make sure they are all happy and know how to contact one of the researchers

**Common questions:**  
Don’t let others wear your camera when you can’t – we want your experiences not your parents or sister for example.

Remember to take it with you if you live in two homes

Help each other out

**Back at the office:**  
Enter details from demographic questionnaire into the Kids’Cam data collection reporting spreadsheet:  
Kids’Cam computer desktop > Kids’Cam admin folder > data collection reporting spreadsheet – enter data into sheet labeled with the school you are working with

Enter phone numbers into Web2Txt/phone (instructions in the back of this handbook)

Remember to text children over the next four days:  
Thurs/Fri: 7am and 7pm  
Saturday/Sunday: 7am, 1pm and 7pm
Equipment collection and data download protocol

Equipment Collection - Monday

1. Text children @ 7am to remind them to bring their equipment boxes to school
2. Take suitcase with you
3. Collect all boxes, making sure that all the equipment is in them. Sign off each participant on school record sheet.
4. Arrange alternative collection with those who have forgotten
5. Download data – follow download protocol for camera and GPS (next page)
6. Make up certificates of participation for the children and school, and letter of thanks for school.
7. Get bag ready for tomorrow:
   a. Invited children / participant list
   b. Scales
   c. Height measure
   d. Laptop and mouse
   e. Recorders x 4
   f. Hard copy of interview schedule (or this handbook)
   g. Participant response sheets (copy in the back of this booklet)
   h. Certificates of participation and vouchers – for children and school
   i. Voucher registry (copy in the back of this handbook)
Image data download protocol

1. **DISCONNECT COMPUTER FROM THE NETWORK**

2. Open KidsCam from Desktop

3. Plug camera into computer

4. When window opens click in window and then enter: ppt # (eg: 2003004) > OK

If window doesn't open, on task bar bottom right: left click up-arrow, right click KidsCam icon and choose 'Searching for Autographer'
5. When download finished click 'close', click on safely remove camera and unplug camera (bottom right task bar)

![Image of safely removing camera]

6. Initial data download checklist

7. Repeat process until all cameras downloaded

8. Check that the photos can be opened in the off-line browser

![Image of checking photos in off-line browser]

9. Check to make sure that the images have been saved

![Image of checking saved images]

10. Make sure you **EXIT THE KIDS'CAM PROGRAMME** before re-connecting to the network
    Go to icons bottom right, left click on up arrow, right click on Kids'Cam icon and click EXIT
Save data to external HD (see page 14).
GPS data download protocol

1. **DISCONNECT COMPUTER FROM THE NETWORK**
2. Turn GPS on
3. Plug GPS into computer
4. Double click on QSports software on Desktop

5. Make sure this area is empty. To remove any tracks, click on a track > remove track, repeat until all deleted
6. Choose ‘Import wizard’ - first icon lower left

Import Wizard will open

7. Click next and wait for the GPS to connect and download data
Make sure that ‘remove drift points’ and ‘Clear GPS device log after import’ are
NOT ticked

Select all relevant tracks (should be all of them)
8. Click FINISH
9. Choose ‘Export Wizard’ – icon second from left at bottom of screen

Choose GPX File
10. Select the items to copy (should be all of them)

11. Save to ‘KidsCam GPX data’ folder on Desktop using participant number (MUST be the same as the camera)
12. Right click on Kids’Cam icon
13. Choose ‘Add GPX file’

14. Choose ‘Browse’ and find KidsCam GPX Data folder on the Desktop
15. Select the participant’s file to copy
16. Enter participant number (MUST be same as the camera)
17. Initial data download checklist
18. Repeat until all data transferred
19. When completed, exit Kids’Cam software
20. Save data to BLUE external HD labeled “Original data” (see page 14)
Saving original data to HD after downloading protocol

Use Blue external hard drive labelled ‘Original data’

On laptop go to: Computer > BLUE HDD > Autographer data > create a new folder
‘schoolname and #’ eg. Newlands400

Open newly created folder > create two new folders: ppt#morn and ppt#after

Plug in Autographer and wait for it to be recognized

On laptop go to: Computer > Autographer E: > copy whole E: folder

Paste into newly created folder

Repeat with other participant camera

Sign off data download checklist

Repeat process for GPS data...create folder etc. The GPS data can all be transferred at once.

Once completed, please safely remove HD from laptop when finished and place HD back into filing cabinet
Review Session Protocol

Thank you for taking part in Kids’Cam you did a great job for us and we really appreciated it. If at any time during this session you don’t want to continue just let me know.

The first thing we’ll do is get you to look through your pictures and delete any that you don’t want us to see. This is going to take about 20 minutes. Ask if they wore the equipment every day and for how long; and if not, why.

Note answers on participant response sheet

Open participant’s images for them to review and show them how to delete, move through the images etc
- Open KidsCam app on Desktop
- Right click on KidsCam icon on bottom right taskbar or if not visible on taskbar, left click on up-arrow first
- Select ‘Review local Autographer data’
- Select participant #
- Open first date they had the camera
- Use the scroll bar on the right of the screen to move down the thumbnails
- Move to next hour using blue right arrow
- Once one day completed go to next day; repeat until all days reviewed
- To delete any pictures, click on image which will put a red border around it, click ‘Delete’; if more than one image to delete in sequence highlight all images first and then click ‘Delete’

When completed, thank the participant.

I would like to ask you a couple of questions about smoking

   a. Is there anyone in your family/household who smokes?
   b. Do you regularly visit houses where there are smokers?

Note answers on participant response sheet

If the child IS SELECTED for an interview, follow protocol for interview
If the child is NOT SELECTED:
Now if it’s ok with you I’d like to measure your height and weigh you.

- Measure participant’s height and weight
  c. Take two measures
  d. Measure again if >1% difference
  e. Note each reading on participant response sheet

Give child (and school) certificate and voucher; get them to sign registry for voucher
Interview protocol

Selection of children to be interviewed
Select the first boy and first girl on the selection list who have consented from each ethnic group. If they do not agree, select the next boy/girl down the list.

Number of children to interview:
Using SWIS as the pilot this will be four children - 2 European, 2 Māori – 2 boys and 2 girls. NB: In total that would give us 68 children (72 total, less 4 from pilot). We want to interview enough children to reach saturation.

Theoretical framework for interviews (do we have one?)
Options: Advertising theory (pp, vicarious learning, and behaviour modification theory.

Methodology thematic/content analysis?
Common themes and content

Take with you from the office:
• Hardcopies of interview schedule
• 4 recorders
• Spare batteries

INTERVIEW SCHEDULE

For those being interviewed
As we said at the beginning, we are really interested in how aspects of your environment influence your health. We are interested in a number of things like physical activity, exposure to alcohol and gambling advertising, but what we are interested in today is the food advertising in your environment. We would like to ask you some questions about that today, is that ok?

• TURN TAPE RECORDER ON
• PLACE TAPE RECORDER CLOSE TO STUDENT
• READ OUT: “This is [INTERVIEWER NAME] interviewing [CHILD NAME AND ID]. The date is [DAY/MONTH/YEAR]
• Do not take any field notes.
• Read out questions and give child sufficient time to answer before using prompts (if there is not much of a response from the participant, reread the question again to check you have their full answer before going on to the prompts).
- All of the prompts need to be read out (although you can read out a couple at a time.

<table>
<thead>
<tr>
<th>Question</th>
<th>Purpose of question</th>
</tr>
</thead>
<tbody>
<tr>
<td>1  What are some unhealthy foods and drinks? What makes them unhealthy?</td>
<td>Info on children’s understanding of nutrition Also unprompted brand recall</td>
</tr>
<tr>
<td>2  What are some healthy foods and drinks? What makes them healthy?</td>
<td>Info on children’s understanding of nutrition</td>
</tr>
<tr>
<td>3  Where do you see or hear ads for food and drinks?</td>
<td>Settings and marketing media type where they see ads</td>
</tr>
<tr>
<td>[prompt] TV, internet, newspaper, magazines, billboards, radio</td>
<td></td>
</tr>
<tr>
<td>[prompt] What about the different places you go . . . Home, school,</td>
<td></td>
</tr>
<tr>
<td>sports (which sports), movies, travelling in car, on streets, in shops</td>
<td></td>
</tr>
<tr>
<td>and supermarkets</td>
<td></td>
</tr>
<tr>
<td>4  What are the different ways that food and drink companies advertise</td>
<td>Knowledge of advertising mediums</td>
</tr>
<tr>
<td>their products? [unprompted]</td>
<td>Recall of marketing strategies or methods</td>
</tr>
<tr>
<td>What about vouchers/player of the day - are these ads? [ask for any</td>
<td></td>
</tr>
<tr>
<td>examples]</td>
<td></td>
</tr>
<tr>
<td>5  What are they trying to do when they advertise food?</td>
<td>Understanding of the purpose of marketing</td>
</tr>
<tr>
<td>6  How would you describe the type of foods marketed? [prompt healthy</td>
<td>General understanding that most marketing is for unhealthy food</td>
</tr>
<tr>
<td>or unhealthy?]</td>
<td></td>
</tr>
<tr>
<td>[Follow on Q if relevant] Why do you think that is?</td>
<td></td>
</tr>
<tr>
<td>7  What can you remember seeing in the ads?</td>
<td>Marketing techniques</td>
</tr>
<tr>
<td>[Follow on Q] Anything else you remember seeing in the ads? [any</td>
<td>General recall of features of ads</td>
</tr>
<tr>
<td>particular food or drink brands or</td>
<td>Product &amp; brand recall</td>
</tr>
<tr>
<td></td>
<td>Question</td>
</tr>
<tr>
<td>---</td>
<td>---------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>8</td>
<td>What do you feel when you see ads for food?</td>
</tr>
<tr>
<td></td>
<td>[Follow on Q] Can you tell me more about that?</td>
</tr>
<tr>
<td>9</td>
<td>Do you talk about the ads with your friends?</td>
</tr>
<tr>
<td></td>
<td>[Follow on Q] Can you tell me more about that?</td>
</tr>
<tr>
<td>10</td>
<td>Who do you think the ads are aimed at?</td>
</tr>
<tr>
<td></td>
<td>[Follow on Q] Why do you think that?</td>
</tr>
<tr>
<td>11</td>
<td>When you have money to buy food or drinks, what do you buy?</td>
</tr>
<tr>
<td></td>
<td>[Follow on Q] Can you tell me more about that?</td>
</tr>
<tr>
<td></td>
<td>[Follow on Q] Where do you buy from?</td>
</tr>
<tr>
<td></td>
<td>Do you buy the foods you see in the ads?</td>
</tr>
<tr>
<td>12</td>
<td>Do you ask your parents to buy the food you see in ads?</td>
</tr>
<tr>
<td></td>
<td>If Yes...</td>
</tr>
<tr>
<td></td>
<td>[Follow on Q] Can you tell me a bit more about that?</td>
</tr>
<tr>
<td>13</td>
<td>Can you remember any of these things in the ads?</td>
</tr>
<tr>
<td></td>
<td>• Free toys [can you give me any</td>
</tr>
</tbody>
</table>

372
- Competitions [can you give me any examples?]
- Cheaper price (two for one ect) [can you give me any examples?]
- Health information [can you give me any examples?]
- Sports heroes [can you give me any examples?]
- Cartoon characters [can you give me any examples?]
- Catchy songs or slogans [can you give me any examples?]
- Free music downloads [can you give me any examples?]
- Text or email messages [can you give me any examples?]
- Messages about fun [can you give me any examples?]
- Use of humour (funny ads) [can you give me any examples?]

14 | Do you believe what they say in the ads?  
   | [Follow on Q]  
   | Why do you say that?  
   | Credibility of marketing information

15 | There are suggestions that unhealthy food and drinks should not be advertised to children.  
   | [Follow on Q]  
   | What do you think about that?  
   | Views on marketing restrictions

16 | If you were the prime minister for a day where  
   | Policy options
<table>
<thead>
<tr>
<th>Views on what to do about it</th>
<th>Duty of care, corporate responsibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>you had the power to change anything you wanted to about ‘advertising unhealthy food and drinks to children what would you change?</td>
<td>Thinking now about food and drink companies that sell unhealthy foods, do you think they care about children’s health and wellbeing? If yes or no ....</td>
</tr>
<tr>
<td>Why?</td>
<td>What makes you say that?</td>
</tr>
<tr>
<td>Would you change anything about unhealthy food advertising:</td>
<td>Thinking about helping children to eat healthy food, who has responsibility for this? [unprompted]</td>
</tr>
<tr>
<td>• on TV</td>
<td>[prompts] What about...</td>
</tr>
<tr>
<td>• in sports</td>
<td>• parents</td>
</tr>
<tr>
<td>• places where children go (schools, parks etc)</td>
<td>• children</td>
</tr>
<tr>
<td>Would you change anything about the way unhealthy food is advertised? For example:</td>
<td>Responsibility</td>
</tr>
</tbody>
</table>
• teachers
• friends
• government
• food companies
• other

19 Is there anything else you would like to say?

Ok, well that’s all, thank you so much for answering all these questions.

Turn tape recorder off.

Now if it’s ok with you I’d like to measure your height and weigh you.

- Measure participant’s height and weight
  f. Take two measures
  g. Measure again if >1% difference
  h. Note each reading on participant response sheet

Give child (and school) certificate and voucher; get them to sign registry for voucher
Post review session protocol

1. Enter details from participant response sheet into the Kids’Cam data collection reporting spreadsheet [Kids’Cam computer desktop > Kids’Cam admin folder > data collection reporting spreadsheet]

2. Back up all data to external hard drive:
   - Use external PURPLE hard drive labeled “post-review” from filing cabinet
   - Plug into machine
   - In PURPLE DH open folder ‘Postreview data’
   - Create new folder of school name and number eg: Wests500
   - In that folder create 2 new folders: ‘Autographer’ and ‘GPX’
   - Copy image data:
     - Local disk C: > Program Files (x86) > DCU > KidsCam > Data > Autographer > select folders to be copied > paste into newly created folder on the HD
   - Copy GPS data:
     - Local disk C: > Program Files (x86) > DCU > KidsCam > Data > GPX > select folders to be copied > paste into newly created folder on the HD

   Please ensure you safely remove the external HD

3. Delete all data from cameras and GPS
   Camera:
   - Plug in Autographer
   - Open Autographer file
   - Delete DATA and LOG folders and .EXT files
   - Please ensure you safely remove the Autographer
   - Repeat for all cameras

   GPS:
   - Open QSports
   - Plug in GPS and ensure it is on
   - Go to import data (bottom left icon)
   - Click ‘Next’
   - Tick all tracks
   - Tick ‘Remove drift points’ and ‘Clear GPS device log after import’
• Click ‘Finish’
• Say yes when asked if you want to clear data
• Click OK
• Remove device and make sure it is turned off
• Remove tracks from programme. In window on the left:
  o Open each folder
  o Highlight first track
  o Click ‘Remove track’ in window at bottom of list
  o Click ‘Yes’ when asked if you are sure
  o Repeat until all tracks deleted
• Delete GPX data from Desktop folder ‘KidsCam GPX data’

Finally...

Connect to the internet and open KidsCam application and leave computer on to transfer files.

**DO NOT DISCONNECT THE LAPTOP UNTIL ALL DATA IS DOWNLOADED**
Audio data download protocol

- Take recorders back to office
- Download recordings onto Kids’Cam PC in the Kids’Cam office (this is backed up by the university system). Save the recordings into “kidscam_qualitivedata” under “KIDSCAM_QUALITATIVE” in the “interviews” folders. At the same time rename the files with the child ID number. (Check all recording is all there… Beginning, middle and end, and that the child name and number match).
  - Transfer recordings (under child ID names) to “kidscamqualitative” folder in Dropbox (folder “to_be_transcribed”)
  - Send email to Rob robhill@es.co.nz to tell him there are new recordings in Dropbox ready to transcribe (and to save each file as under the child ID number). Include a ‘read receipt’ in the email.
  - Delete recordings from recorder.
  - Document in the Excel spreadsheet under “kidscamqualitative” folder “transcribing log” that recordings have been sent to Rob and deleted off the recorder.
  - Rob will return the transcripts by putting them in Dropbox under the “kidscamqualitative” folder under “completed_transcripts”.
  - Check the completed transcripts and resave each file after removing the child’s name (but leave the child ID).
  - Document that transcripts have been returned, and anonymized in the Excel spreadsheet “transcribing log”.
  - Save the anonymized transcripts onto the Kids’Cam PC folder “kidscam_qualitivedata” under “KIDSCAM_QUALITATIVE” and save into the “Anonymised transcripts” folder.
## Data download checklist

Cycle and school number:

<table>
<thead>
<tr>
<th>Ppt#</th>
<th>Morning camera</th>
<th>Afternoon camera</th>
<th>GPS</th>
<th>Backed-up to 'original' HD</th>
<th>Backed-up to 'post-review' HD</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>
Participant response sheet

<table>
<thead>
<tr>
<th>Participant number:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date:</td>
</tr>
<tr>
<td>Camera wearing experiences:</td>
</tr>
<tr>
<td>Smoking at home:</td>
</tr>
<tr>
<td>Smoking other places:</td>
</tr>
<tr>
<td>Height (2 measures)</td>
</tr>
<tr>
<td>Weight (2 measures)</td>
</tr>
<tr>
<td>Other notes:</td>
</tr>
</tbody>
</table>
**Data collection checklist**

**School number:**

**Pre-briefing checklist**

<table>
<thead>
<tr>
<th>Completed:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Check that:</strong></td>
<td></td>
</tr>
<tr>
<td>• Data removed from equipment</td>
<td></td>
</tr>
<tr>
<td>• Equipment charged</td>
<td></td>
</tr>
<tr>
<td>Contact details of researchers on instruction booklet</td>
<td></td>
</tr>
<tr>
<td><strong>Invited children / participant checklist</strong></td>
<td></td>
</tr>
<tr>
<td>Equipment boxes completed</td>
<td></td>
</tr>
<tr>
<td>• 2 x cameras</td>
<td></td>
</tr>
<tr>
<td>• 1 x GPS</td>
<td></td>
</tr>
<tr>
<td>• Laminated cards</td>
<td></td>
</tr>
<tr>
<td>• Chargers</td>
<td></td>
</tr>
<tr>
<td>• Instruction booklet</td>
<td></td>
</tr>
<tr>
<td>• Sticker on lid for participant number</td>
<td></td>
</tr>
<tr>
<td>Bags packed</td>
<td></td>
</tr>
<tr>
<td>Spare equipment</td>
<td></td>
</tr>
<tr>
<td>Copies of briefing protocol (in this handbook)</td>
<td></td>
</tr>
</tbody>
</table>

**After briefing:**

<table>
<thead>
<tr>
<th>Completed:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Information in demographic questionnaire entered into spreadsheet</td>
<td></td>
</tr>
<tr>
<td>Consent forms in folder in filing cabinet</td>
<td></td>
</tr>
<tr>
<td>On collection:</td>
<td></td>
</tr>
</tbody>
</table>
- Check all equipment collected
- Report broken equipment

After collection:

Data downloaded from camera and GPS
Data backed up to BLUE HD labeled ‘original’
Data deleted from equipment
Clean equipment
Recharge equipment
Delete numbers in phone

**Review/interview checklist**

Do you have:

- Recorders
- Hard copy of interview schedule (in this handbook)
- Scales
- Stadiometer
- Spare batteries
- Participation certificates printed and signed
- Voucher registry
- Letter of thanks for school printed and signed
- Letter of thanks for non-participating children

**Post review checklist**

Interview data downloaded
<table>
<thead>
<tr>
<th>Interviews cleared from recorder</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information on response sheets entered into spreadsheet</td>
</tr>
<tr>
<td>Data backed up (check data download checklist)</td>
</tr>
<tr>
<td>Data transferred to KidsCam computer</td>
</tr>
<tr>
<td>All forms in folder in filing cabinet</td>
</tr>
</tbody>
</table>
## Invited children / participant list

**School #:**

**Date:**

<table>
<thead>
<tr>
<th>Surname</th>
<th>First name</th>
<th>PPt number</th>
<th>Box number</th>
<th>Date given out</th>
<th>Date collected</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>
Putting numbers into phone

Menu
Select contacts
Select add contacts
Enter participant number eg x00x00n

Note: this comes up with an unusual entry but that’s okay

Enter phone number for that participant
Select use
Select back
Keep entering numbers until all entered

On menu select messages
Scroll down select distribution list
Select options
Select add list
Enter a name – suggest ‘school’
Select the name of the list and select options
Select view list
Select options
Select add contacts
Select the contact names you have entered

When done go back to main screen
Thank goodness for smart phones!
To send a text to the distribution list:

Select *menu*

Select *messages*

Scroll down to *distribution list*

Select the list

Select *options*

Select *send message*

Type message and send
Appendix 4 Project Instruction Booklet

K ids’Cam

Project Instruction Booklet
Project instructions

Welcome to Kids’Cam!

Thanks for being part of this exciting project.

We hope you have fun and enjoy being part of a world-leading research project about young people’s lives.

If at any time during the project you don’t want to be part of the study anymore, that’s fine, either your parent or caregiver just need to contact a member of the research team and let us know.

In this booklet you will find:

- Project instructions – what you need to do
- Instructions on how to use the Autographer
- Instructions on how to use the GPS device
- Where and when you should turn off or take off the camera
- A checklist for the equipment kit for when you return it.

If you are having problems with the equipment or if you or your parents have any other questions please call:

Michelle Barr 021 0852 4524
Moira Smith 021 0856 9827
Project Instructions

• Wear the camera and the GPS for 4 full days – Thursday to Sunday.

• Go about your day as normal. Don’t change anything you do during the day. Even if you think it may be uninteresting and boring!

• The Autographer needs to be worn on top of your clothing.

• Hang the Autographer around your neck AND clip it to your clothing. It keeps it safe and is more comfortable to wear.

• Remember to put all the devices on to charge before you go to bed each night.

• On Monday please bring all of the equipment back to school so that we can collect it.
In the mornings:

- Turn on your morning Autographer – the one with a ‘morn’ sticker on it and an odd number - and start wearing it.
- Turn on your GPS and start wearing it.
- Make sure you have your information cards to give out.
- Take your second camera with you.
- Before you leave school, turn on your afternoon camera – the one with a ‘aftern’ sticker and even an even number – and start wearing it. On the weekends do this at 1pm.

During the day:

- check every now and then that the Autographer is working:
  - the blue circle will be blinking, or
  - press the top button once quickly - words will come up on the front of the camera. They will go off automatically.
- If it isn’t working the battery may be flat, so put it on to charge and start using your second camera.

Before going to bed:

- Plug in both of the Autographers and the GPS device to charge.
Where and when should you take the Autographer off?

You can turn off or take off the Autographer anytime you don’t feel comfortable wearing it.

You will need to turn off or take off the Autographer in the following places:

- Before going to the bathroom or getting changed.
- In public bathrooms and changing rooms and showers (including those at school, sports clubs, and swimming pools).
- Public swimming pools.
- Anytime you are around anyone that is not fully clothed.
- In hospitals, hospices, and doctors’ offices.
- In shops, supermarkets and other buildings where there is a notice or sign that says you can’t take photos.
- If on a marae, check with the person in charge to make sure it is okay to wear the camera.
- If someone asks you to take it off.
- Before playing contact sports (like rugby). You shouldn’t need to take it off at lunchtime or break times, unless you are doing something you think might damage the Autographer.
- Before you go swimming. The Autographer is not waterproof.
- If it is raining really heavily and you think it might get wet while you are outside.

**BUT PLEASE REMEMBER TO PUT IT BACK ON!**

Don’t worry if you forget to take it off - you will be the first person to see the photos and you will be able to delete anything you don’t want us to see.
Instructions for camera

- TEST BUTTON
- ON / OFF
- PRIVACY DIAL
- LENS
- CHARGER GOES HERE
Instructions for camera

How do I turn it on? Press and hold the ON / OFF button for 5 seconds until the blue words ‘AUTOGRAPHER’ and ‘Hello’ come on the front of the camera

How do I turn it off? Press and hold the ON / OFF button for 5 seconds until the blue words ‘Goodbye’ come on the front of the camera and it turns off

How do I know it’s working? The blue light will blink
or
Press the TEST BUTTON ONCE; the blue words will show if on

What if it won’t turn on? The battery could be flat – put it on to charge and use the other camera

How do I know it’s charged? The ‘battery’ symbol will be solid

NOTE: If the privacy dial is turned to yellow or the lens is covered for more than 5 minutes the cameras will shut off. You will need to open the privacy dial and turn the camera on.
Instructions for GPS

How do I turn it on? Press and hold the ON / OFF button for 5 seconds until the 2 symbols come on
Release button

How do I know it’s working? The GREEN symbol will be flashing
The ORANGE symbol will be flashing or on

How do I turn it off? Press and hold the ON /OFF button for 5 seconds until the symbols flash and then disappear

How do I know it’s fully charged? The battery symbol will be flashing when plugged in for charging
Equipment Kit Checklist

1 x GPS device and armband
2 x Autographers
3 x chargers
1 x 4-pin plugboard
Instruction booklet
Appendix 5 Pilot Study Focus Group Interview Schedule

Pilot study focus group - Interview schedule

1. What was it like to wear the equipment for the full four days?

2. How did you feel about wearing the Autographer?

3. How often did people approach you about it? What did they ask you?
   a. Was anyone not happy about you wearing it?

4. How could we make things easier and better for you?

5. What did you think about taking part in the project? Would you do it again?
Appendix 6 Kids’Cam Risk Management Strategy

Kids’Cam risk management strategy

Before conducting the full Kids’Cam study, a risk management strategy was developed to identify major risks to the study and ways to minimise these risks. The risk management strategy was developed by MB using the key issues identified in the application for ethical approval, and findings from the 2012 feasibility study and the 2014 pilot study. Outlined below were the foreseeable risks for each stage of the study, their likelihood of occurring, their impact and the actions that were taken to mitigate these risks.

Pre-data collection

Difficulty with school recruitment – Likelihood medium - impact high

As Kids’Cam participants were recruited through schools, difficulty with school recruitment would have a high impact on the project. It is likely we would encounter opposition from the schools if the school does not see value in participating in the project, or does not consent to the use of the Autographer on school grounds. To address this issue a protocol for approaching and recruiting schools was developed by me, LS, and MS. The protocol for school recruitment can be found on page 350, Appendix 3.

The principal at each potential school was initially phoned by LS or MS to gauge their interest in the study. If interested in participating, the school information sheet and consent form was emailed to the principal and a meeting time between Kids’Cam researchers and the school principal was arranged. At initial meetings with principals, the novelty of the technology and the study were emphasised. However, schools were not informed of the food marketing focus of Kids’Cam but rather were told that we were interested in children’s environments and how these may impact on their health. During this meeting the protocols for protecting the privacy and anonymity of participants, their families, other school children and the staff were discussed and any questions answered. At this time we also discussed the feedback we had received from participants and staff from the
feasibility and pilot studies. Specifically, that the children had enjoyed participating and that teachers involved found the project to be less burdensome than expected.

At this meeting we also discussed the importance of informing the school community about the study, asked how best to do this, tailoring our approach to each school, and offered our assistance. Complaints from members of the school community about the use of wearable cameras at school was a risk that could have an adverse impact on the study. To mitigate this risk, we asked that participating schools published a notice about the study in the school newsletters at least one week in advance of participant recruitment. This notified parents that, cameras would be used at school and that identifiable features of all people or places captured in the images would be obscured in all disseminated material; access to the images was restricted to members of the research team, and that Autographers do not record audio or video. Collectively, and on the advice of schools principals we decided that one week was an adequate amount of time within which parents could raise their concerns with the school, should they wish. Members of the research team also offered to make themselves available to meet with concerned parents after school to discuss the project if necessary. In recognition that some parents may voice concerns during data collection, we informed the principals that they could withdraw their school from the study at any time up until the competition of data collection.

**Difficulty with participant recruitment – Likelihood medium – Impact high**

Similar to school recruitment, difficulty with participant recruitment was an issue with a potentially high impact on the study. To reduce this risk, Year 8 school roll and ethnicity information was obtained from the Ministry of Education for all eligible schools in the Wellington region. Schools with very low numbers of Pacific and Māori children were excluded from the sampling frame. Exclusion of such schools improved the likelihood of there being sufficient numbers of children for the selected ethnicity at each of the selected schools. Further, to enable adequate time for participant recruitment, an invitation session with possible participants was held two weeks in advance of the proposed start date at each school.
However, during the first round of data collection, the participant response rate was only 50%. As such, the protocol for recruitment was adapted so that for every group of six participants required, 20 children would be randomly selected and invited to participate. This was the list of invited children. This list was then sent to the facilitating teacher who assessed the children against the inclusion and exclusion criteria. Typically this reduced the list by three to five names, resulting in a list of 15–17 children to invite for every six children required. If more than six children consented, the first six children on the randomly selected list would be chosen. If the initial selections did not consent to participate the next children on the list would be included.

**Data collection**

During data collection, there were a number of potential risks to the project as outlined below.

**Capture of third parties in images – Likelihood high – impact low**

Capture of third parties in the images was an issue with a high likelihood of occurring but a low impact on the study overall due to the strict data handling, storage and dissemination procedures that were developed for the study. Specifically, all information and consent forms and briefing conversations emphasised that identifying features of all of the people would be obscured to prevent them being recognised in any pictures used during the dissemination of findings. Participants were given an information card to pass out and the following statement to recite: “I am part of a study run by the University of Otago that is looking at my environments. I am wearing a camera that takes a picture every 10 seconds. But the camera is not deliberately taking pictures of individual people or places.” The information card also stated that the raw data would not be released into the public domain and that it will only be accessed by members of the research team. Further, to reduce possible repercussions from uninformed school staff, principals were asked to brief staff on the project and discuss that the cameras would be present on school grounds and would be worn by children during class time.
Capture of personal activities, e.g. changing or using the bathroom – Likelihood high- impact low

Accidental capture of the participant engaging in personal activities such as using the bathroom was considered highly likely to occur. During the briefing session, children were instructed to turn the camera off, engage the privacy dial, or remove the camera before using the bathroom or any other personal activities. Participants were also given the opportunity to review their images, in private, to delete images that they did not want the research team to see. Further, participants were specifically asked to delete any images in which a person was not fully clothed and those that they had captured in the bathroom.

Taking images in private places – Likelihood medium- impact medium

Capturing images in private places was a potential risk to the privacy of members of the public or members of the participant’s households, and had the potential for negative repercussions for the participants in these situations. To reduce the risk of participants capturing images of personal activities or in places in which photography is prohibited by law, they were instructed to remove the camera in the following situations:

- Before going to the bathroom or getting changed.
- In public bathrooms and changing rooms and showers (including those at school, sports clubs, and swimming pools).
- Public swimming pools.
- Anytime they were around anyone that was not fully clothed.
- In hospitals, hospices, and doctors’ offices.
- In shops, supermarkets and other buildings where there is a notice or sign that prohibits photography.
- If someone asked them to take it off.
Children being approached about the camera was considered highly likely and of moderate risk to the children. As members of the research team could not be there to deflect the attention, children were given information cards to give out to anyone that was interested in the camera or project. The cards included the names and contact details of the research team and encouraged the reader to contact members of the research team for further information or if they had any concerns. In their instruction manual, children were also provided with a statement to recite that stated that they are participating in a study being conducted by researchers from the University of Otago, Wellington; that the project aimed to document their environment; and that they were wearing a camera that automatically took pictures continually throughout the day. Furthermore, they were advised to say that they were not intentionally taking photographs of specific people or places. They were also encouraged to tell interested parties to contact the researcher using the contact details given on the information card if they required additional information or had further questions.

**Wearing the Autographer in shops – Likelihood high- impact low**

Children were not instructed to remove the Autographer before going into shops. However, they were instructed to remove the camera before entering: shops, supermarkets and other buildings where there is a notice or sign that specifically prohibited photography. There was a high likelihood of children wearing the Autographer into retail shops as part of their normal daily activities; however, this was determined to be a risk with a low impact as children had been briefed on how to handle any attention they may receive as outlined above.

**Capture of Illegal activity – Likelihood low- impact low**

The likelihood and impact of this occurring would be low. It is unlikely that a participant would engage in illegal activity while wearing the Autographer. If the activity of this nature was captured, it is likely that the participant would delete these images before the research team reviewed their data. Legal advice was sought and provided by University solicitors. Following a meeting between LS and the University solicitors, they sent an email to LS containing their advice. LS then
discussed this advice with MB. This advice was discussed by core team members to ensure all team members were aware of their responsibilities should something of this nature appear in the data.

**Image data released into the public domain – Likelihood low- impact high**

A further issue was the risk of having image data released into the public domain. The risk of this occurring was low due to the protocols developed to ensure data was securely stored at all times on password-protected laptops, external hard drives, and an on-site server. If the raw image data were to be released into the public domain the privacy and anonymity of the participants, third parties in the images and the study location would be compromised. To prevent this, images were stored securely on a server at the University of Otago Wellington, accessed only by members of the research team. Ownership of participant images was also transferred to the research team at the informed consent stage and participants had no further access to the images once they had reviewed them. This was necessary to ensure that the images did not end up on social media or photo sharing websites.

**Incomplete data collection –Likelihood medium – impact medium**

**Non-systematic data loss**

It is highly likely that partial data losses will occur due to issues with camera operation and children forgetting to wear/ charge camera. To reduce the risk of data losses, the participants were given a comprehensive briefing and instructions on how to use and charge the Autographer and GPS device correctly. Participants and their parents were asked to provide a cell phone number so that a text could be sent to the participant or a parent to remind them to wear the equipment each morning and to charge equipment each night, for the duration of data collection. Data sets with non-systematic data losses, that is, those with data missing completely at random, were included in the analysis. The four-day data collection period included a margin for some data loss.

**Systematic Data loss**
In contrast to the low impact of non-systematic data loss, systematic data losses resulting from participants turning off the camera repeatedly for long periods would have a much greater impact on the study. To reduce the risk of this type of data loss, participants were asked to wear the device to the best of their ability for the full four day period. Although participants were informed that they could remove the device at any time, we emphasised that they should put the device back on afterwards.

**Failure of the Technology – Likelihood medium – impact high**

Data losses due to the failure of the Autographer or GPS device would have a high impact on the study. To reduce this risk, ongoing staff training on how to use equipment and its proper functioning was conducted. Following every cycle of data collection, the devices were all checked to ensure they were functioning correctly for the next cycle of data collection. Broken equipment was replaced at this time. Participants were given the contact phone numbers of members of the research team and were encouraged to contact the researchers if there were functional issues with the equipment.

**Loss of equipment – Likelihood medium- impact medium**

To reduce the risk of losing equipment, members of the research team kept in regular contact with participants via text message. Children, or their parents, were texted on a Sunday night and Monday morning reminding them to return the equipment to school. The loss of some equipment was budgeted for, and there was a small supply of spare equipment available at all times during data collection. Of the 25 data collection rounds conducted in 16 schools, two GPS units two were lost and two broke. Over the whole study period, four Autographers broke.

**Study documents**

**Unclear operating procedures / protocol not adhered to- Likelihood low – impact high**

To reduce the risk of the protocol being unclear or not adhered to, clear and user-friendly, comprehensive, practical and relevant study protocols were developed.
by MS and MB. The protocol was regularly updated, and reasons for the updates were recorded. All members of the research team were informed of protocol changes, and training on protocol changes was conducted.

**Inaccurate and/or incomplete collection of data - Likelihood low - impact high**

To reduce the risk of inaccurate and/or incomplete collection of data a Kids’Cam training day was held to ensure all team members were competent in using the equipment and could conduct an invitation, briefing and review session. On-going training was also conducted to ensure all researchers were familiar with data the collection protocol.

When TC joined the Kids’Cam team, MB provided training on data collection methods from recruitment of schools through until the end of data collection. TC accompanied MB on two full rounds of data collection in two schools and was supervised on a third round of data collection before being allowed to conduct data collection alone.

In general, if there were 12 or more participants in a round of data collection, two researchers were required to attend the invitation, briefing, and review sessions. In addition to these procedures, MS and MB developed detailed, clearly written protocols for data collection procedures and developed checklists for each session with the participants to ensure that all researchers had the required equipment and paperwork to complete each session. Further, researchers checked all forms were properly completed before leaving each school, following data collection. A data collection excel spreadsheet was developed to record all demographic, participant responses and participant height and weight measurements. At the end of each round of data collection, the data collection spreadsheet was reviewed to ensure that all participants responses and measurement had been entered correctly.

**Study conduct/recruitment**

**Informed consent not completed correctly - Likelihood low - impact medium**
To address this issue, researchers checked that all parent and child consent forms had been signed and completed appropriately at the briefing session, before admitting a participant to the study. For school consent, verbal or written consent (in the form of an email) was obtained before data collection. However, signed consent forms from the school principal were typically obtained on the first day of data collection.

**High dropout rate- Likelihood medium- impact high**

Researchers maintained regular contact with participants (via text message) during the study period to reduce the risk of drop out. During both the invitation and briefing sessions, the expectations and requirements of the study were also outlined explicitly to ensure participants were fully informed of what they were being asked to do.

**Ethics updates- Likelihood low- impact medium**

The research team worked very closely with the chair of the ethics committee throughout the development of the study. All changes to the protocol were immediately sent to the University of Otago Human Ethics Committee for approval. Ethics was a weekly agenda item for the Kids'Cam team meeting to ensure items for ethics were discussed and brought to the attention of the ethics committee for approval.
Data management / IT

**Missing data - Likelihood low - impact high**

To reduce the likelihood of missing data, members of the research team conducted ongoing monitoring of the data collection spreadsheet to ensure the spreadsheet had been completed following each data collection round.

**Data loss – Likelihood medium - impact high**

Due to the key role of technology in this study, the potential loss of image and GPS data as a result of human or computer error was highly concerning. To reduce the risk of this occurring, both image and GPS data was backed up on encrypted external hard drives that were stored in a locked filing cabinet when not in use. In addition to being stored on the server computer in the Kids'Cam office, all of the data was backed up using the University's secure cloud storage system, Syncplicity. Completed consent and demographic information sheets were also stored in a locked filing cabinet in line with ethics requirements.
## Core Breakfast Cereals

<table>
<thead>
<tr>
<th>Sanitarium Weet-Bix</th>
<th>Sanitarium Skippy Cornflakes</th>
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<td>Sanitarium Weet-Bix Gluten Free</td>
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<td>Vogel's Original Muesli - Natural Apricot</td>
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<td>Kellogg's Rice Bubbles</td>
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<td>Kellogg’s Mini-Wheats Little Bites</td>
<td>Harraways Fruit Harvest</td>
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<td>Uncle Toby's Quick Oats</td>
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<td>Freedom Foods Rice Flakes</td>
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<td>Natures Path Millet Puffs</td>
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## Core Yoghurts - Milk & Milk Products

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<th></th>
<th>Description</th>
<th>Examples</th>
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<td>2.</td>
<td>Meadow Fresh Lite Yoghurt <strong>Product Range 1kg</strong></td>
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*Note: The images are placeholders and should be replaced with actual images.*
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<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Schweppes</td>
<td>94.6% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Sea Lord</td>
<td>92.3% Permitted</td>
<td>Core</td>
</tr>
<tr>
<td>Sea star</td>
<td>100% Permitted</td>
<td>Core</td>
</tr>
<tr>
<td>Shultz</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Silver fern farms</td>
<td>100% Permitted</td>
<td>Core</td>
</tr>
<tr>
<td>Simply Squeezed</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Skittles</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Snickers</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Soda Stream</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Southern ocean</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Spam</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>SPC</td>
<td>100% Not permitted</td>
<td>Core</td>
</tr>
<tr>
<td>Sprite</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Spree (drinks)</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Starburst</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Streets</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Supersnack</td>
<td>87.5% Permitted</td>
<td>Core</td>
</tr>
<tr>
<td>Sweet As Popcorn</td>
<td>100% Not permitted</td>
<td>Non-core</td>
</tr>
<tr>
<td>Symbio</td>
<td>100% Permitted</td>
<td>Core</td>
</tr>
<tr>
<td>Talley's</td>
<td>82.6% Permitted</td>
<td>Core</td>
</tr>
<tr>
<td>Product</td>
<td>Percentage</td>
<td>Permitted Status</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Tararua</td>
<td>91.7%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Tasti</td>
<td>67.1%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Tegel</td>
<td>80.5%</td>
<td>Permitted</td>
</tr>
<tr>
<td>The Chicago Pizza Company</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>The Collective Dairy</td>
<td>97.4%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>The Natural Confectionery Company</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>The smoke house</td>
<td>60%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Thornton’s</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Tic-Tac</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Tip Top</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Tip Top Bakery</td>
<td>60%</td>
<td>Permitted</td>
</tr>
<tr>
<td>Toblerone</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Top Hat</td>
<td>50%</td>
<td>Permitted</td>
</tr>
<tr>
<td>Trident</td>
<td>55.6%</td>
<td>Permitted</td>
</tr>
<tr>
<td>Turk’s Chicken</td>
<td>71.4%</td>
<td>Permitted</td>
</tr>
<tr>
<td>Twix</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Uncle Toby’s</td>
<td>62.5%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>United Fisheries</td>
<td>100%</td>
<td>Permitted</td>
</tr>
<tr>
<td>V energy drink</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>V8 Juice</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Verkerks</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Vita Fresh</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Vitasoy milk</td>
<td>56.3%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Vogel’s</td>
<td>51.4%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Wave</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Werther’s originals</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Whittaker’s</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Wheelies</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Wonka</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Yarrow’s</td>
<td>57.1%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Yoplait</td>
<td>79.5%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Zero Water</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
<tr>
<td>Zombie Energy Drink</td>
<td>100%</td>
<td>Not permitted</td>
</tr>
</tbody>
</table>
Appendix 9 Kids’Cam Annotation Protocol

KIDS’CAM ANNOTATION PROTOCOL
Study objective:

To examine food environments, specifically:

The **frequency**, **duration** and **nature** of children’s exposure to food and non-alcoholic beverage marketing, documenting differences by **setting**, and exploring ethnic and socioeconomic differences.

Study Definitions

**Marketing:** “any form of commercial communication or message that is designed to, or has the effect of, increasing recognition, appeal and/or consumption of particular products and services. It compromises anything that acts to advertise or otherwise promote a product or service.” (WHO, 2012).

**Marketing Encounter:** When food marketing of a single type for the same product is present in at least one image until it is followed by 3 consecutive images where the logo/product is completely absent. Note: there may be more than one marketing encounter in an image.

**Frequency:** The number of independent marketing encounters that contribute to the total number of exposures to food and beverage marketing.

**Duration:** The exposure to food and beverage marketing as a unit of time.

**Nature:** The types of exposure in relation to the way the product is advertised. Relates to the marketing medium used to advertise the product as well as the setting the marketing exposure occurs in.
Logging in as User

1) Type in the Kids’Cam URL http://139.80.145.170 into the web browser (Google Chrome) of a computer connected to the University of Otago Server.

2) Type in your username and password to access the photos you have been personally assigned.
Accessing Photos

1) Once logged in your assignments will appear. In order to access a participant’s photos click on the annotate button

![Assignments for Tim](image)

2) Next click on the date you are interested in using the calendar function and then select the time by clicking on the appropriate hour.

![Calendar and Times](image)
Annotating an Image

1) Annotations must be made after having magnified the image by clicking the magnify function. Further magnification is permitted if necessary by clicking on the image once. The image will appear in a new tab fully magnified.

2) Alternatively, you can zoom in 300% then the thumbnails become the same size as a magnified image and magnification is not required in order to code.

3) In order to annotate an image you must click out of the magnified image and click on the image you wish to annotate. Selection is symbolized by the blue border.
4) Annotators are to code images in the following sequence:
   *Setting > Marketing Medium > Product Category*

5) First the image must be coded for setting (see setting definitions) using the annotation ontology bar to the left of your screen.

6) Once setting is selected the ontology will open up a selection of marketing media. Once determined (see definitions) select the appropriate marketing medium.
7) Once the marketing medium is selected a range of product categories will appear. Once determined (see product categories) select the appropriate product category and the photo will be annotated. A green marker will appear to inform you the image has been annotated.

8) You can also annotate multiple images if the same event is occurring. Simply click on all the images you want to annotate and assign them with the appropriate annotation by following the process above.
9) Make sure you deselect the images before making another annotation by hitting the ‘deselect’ button.

10) To delete an annotation select the photos you want to remove the annotations from. Then pull curser over highlighted ontology level and a red X will appear. Click the X.
Annotation Rules

1) i) For an image to be coded, there must be 50% of the logo or brand name or registered trademark (colours and shapes do not count) present in the Initial frame.

ii) Subsequent images that contain any part of the logo or that product’s associated branding may be coded as long as they are part of the same marketing encounter.

iii) Some of the marketing must be present for rule 1 ii to apply. Example image is codable but would not be without the label being present.

iv) When coding subsequent images within a marketing encounter you must be 50% or more sure that the product/advertising you see is the same as the one in previous images.

i) 50% or more of the brand

ii) Part of the associated branding

iii) label not present - not coded

2) A marketing encounter is considered finished when there are three or more consecutive images without the product name or logo or associated branding.
3) If there are no logos/products in an image the image must be coded for setting. The next two levels of the ontology will be coded default and default_1 respectively.

Private Transport (setting) ➔ Default (marking medium) ➔ Default_1 (Product)

4) The setting is coded by where the marketing event is occurring not where the participant is standing (see definition). Because the marketing is occurring within the Convenience Store this image would be coded: Convenience Store- Indoor (setting) ➔ In-Store marketing (marketing medium) ➔ Convenience Store (product)

5) When coding an image with multiple settings make sure you could each setting independently to limit any potential error. For example,
This image has 2 annotations on the street and two annotations for shop front which should be coded:

Street ➔ Vending machine external ➔ Sugary drinks and juices 1

Street ➔ Product Packaging ➔ Sugary drinks and juices 1

Then:

Shop Front ➔ Sign ➔ Ice Cream 1

Shop Front ➔ Sign ➔ Convenience Store 1

6) Note there may be two brands on one product/Advertisement which both need to be coded for. For example:

Fastfood (burger King) + Sugary Drink (coke)  Confectionary(Whittaker’s)+Cookies, Cakes, Pastries (Griffins)  Fastfood (Mc Donalds) + Sugary Drink (Code)
7) Due to the difficulty in trying to code supermarkets and convenience stores these settings have also been created as product categories.

E.G. Convenience Store- Indoor (setting) → In-store Marketing → Convenience Store

Supermarket_indoor (Setting) → In-Store Marketing → Supermarket (product)

8) You can annotate a series of images at once by selecting each individual image as indicated by the blue boarder and give them the appropriate annotation. You can annotate all images then go back and retrospectively annotate the images with junk food marketing in order to save time.

9) If there are 2 or more pieces of marketing in the same image that are the same Setting/marketing medium/product category (but different brands) then they are coded as:
Full Service Restaurant ➔ Product Packaging ➔ Sugary drink 1

This image also contains another product category so there would be an additional annotation:

Full Service Restaurant ➔ Product Packaging ➔ Diet Drink

10) We are NOT coding for condiments (see extra definitions) so do not try and code these images
For example in this image the butter and Marmite would not be coded for as they are condiments.

11) Because we are specifically interested in mobile food vendors these are coded differently. First you code for the setting they appear in then select mobile food vendor and then the product category they are advertising.

Fresh food market → Mobile Food Vendor → Fast food

Fresh food market → Mobile Food Vendor → Sugary drinks and juices

12) Because it can be difficult to determine the difference between convenience stores and supermarkets from the outside it is possible to retrospectively annotate these if new information is presented that changes code. For example

Initially coded as Supermarket
Then coded as Convenience Store
In this situation it is acceptable to retrospectively go back and re-annotate the supermarket tags as convenience store

13) There are both healthy and unhealthy milk products (Yogurts) and cereals. These have been divided through nutrient profiling (see nutrient profiling). If a brand appears that does not appear on the list of options in the nutrient profiling section then it is an unhealthy product.

14) If it takes you longer than 10 seconds to determine whether marketing is clearly present then do not code the image.

15) You **MUST** take a short break every 30 minutes of annotation as continuous spells of annotation over this time are prone to measurement error.

16) From the 28\textsuperscript{th} of September 2014- 5\textsuperscript{th} of April 2015 the times have not been adjusted for daylight savings. For example, the annotation framework will show 6am when it is really 7am. Participant numbers 600800-190120 affected.

**Uncodable Images**

Images which are uncodable include:

1) **Camera taken off** – When the participant has removed the camera. Generally, the position of the image or a set of images remains the same in relation to fixed objects. Lighting commonly changes without the movement of the camera.
Setting → Camera taken off (Marketing Medium) → Camera taken off_1 (product)

2) Any image or set of images where the visibility of the image is poor to the extent the coder is unable to accurately determine what is happening in the image or series of images in question. Could be due to blurred/dark/obstructed images.

No setting → Uncodable (Marketing Medium) → Dark/Obstructed/Blurred (product)

3) If the setting can be determined based on the image in context to other images then the image is codable. For example:

School → Default → Default_1

Uncertain of Correct Annotation

1) If a coder is uncertain on what an image should be coded as or whether it should be coded at all they may code it uncertain. The image will be coded later by either M/T.

Uncertain → uncodable → Check
Nutrient Profiling

There are two product categories that are included in both healthy (Core) and unhealthy (everything else) foods. These two product categories are cereals (unhealthy) and milk products (unhealthy). For these categories you will need to consult the nutrient profiling system in order to determine if the product is healthy or unhealthy (see nutrient profiling manual).

Computers

1) Images are only to be coded using an external computer screen no larger or smaller than 22’. Do not code using a laptop screen or the Kids’Cam server screen.

2) Always use the Google Chrome internet browser to access and analyse the images as the annotation framework has been optimised for this platform.

Data Analysis Rules

1) For images that are separated by less than 1 second the first image will be counted towards the data analysis. Any subsequent images within the 1 second time lapse will be removed from the analysis.

Ethics

1) Keep the identifiable features of the data confidential; these features of the data should not be discussed with anyone outside the research team.

2) Do not leave data or equipment containing unsecured data unattended. If you leave your computer for any amount of time you must log out.

3) The University of Otago (Wellington) possesses ownership of all image data. Applicants cannot copy data without the written approval of the Principal Investigator or retain copies of the data after completion of work. Any data copied or released must be stored on a password protected device and must have gone through the appropriate anonymised procedure.

4) Protect the anonymity of all participants, third parties and their environments. To protect the privacy of those who may be inadvertently captured in the images, all images used in disseminated material will have identifiable people, street names, places, retail outlets, businesses and school names blurred. The demographic information collected will only be viewed by the core Kids’Cam team.
## Extra Definitions

Annotations for images that are unable to be coded or where the camera has remained static

<table>
<thead>
<tr>
<th>Setting</th>
<th>Camera not worn</th>
<th>Camera not worn_1</th>
</tr>
</thead>
<tbody>
<tr>
<td>No setting</td>
<td>Uncodable_1</td>
<td>Blurry/blocked</td>
</tr>
</tbody>
</table>

Where there is no food marketing to be coded, i.e. to be coded for setting only

| Setting     | Default         | Default_1        |

Uncertain about coding

| Uncertain   | Uncertain_1     | Check            |

Extra

| Condiments  | Items that are added to food to add flavour such as salt, pepper and spreads. |
References

Auckland City Council. (2013). Food Safety Bylaw 2013 Auckland Auckland City Council


## Appendix 10 Supplementary results tables

Table 45 Mean rates (with 95% confidence intervals) of exposure from Poisson regression for non-core advertising by setting with rate ratios (with 95% confidence intervals) comparing exposure rates within demographic groups

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Street</th>
<th>Shop front</th>
<th>Fresh food market</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95% CI)</td>
<td>p value</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>1.9 (1.1-3.1)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>2.0 (1.4-2.8)</td>
<td>1.0 (0.6-1.9)</td>
<td>0.880</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.0 (0.3-3.0)</td>
<td>0.5 (0.2-1.8)</td>
<td>0.279</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0 (0.6-0.7)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>2.5 (1.9-3.3)</td>
<td>2.5 (1.4-4.6)</td>
<td>0.004</td>
</tr>
<tr>
<td>High</td>
<td>1.7 (0.9-3.3)</td>
<td>1.8 (0.8-4.1)</td>
<td>0.167</td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>1.9 (1.2-2.8)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>1.3 (0.6-2.9)</td>
<td>0.7 (0.4-1.2)</td>
<td>0.172</td>
</tr>
<tr>
<td>Obese</td>
<td>2.0 (1.1-3.7)</td>
<td>1.1 (0.5-2.5)</td>
<td>0.824</td>
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<tr>
<td>Gender</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>1.8 (1.2-2.8)</td>
<td>1.0</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1.7 (1.0-3.1)</td>
<td>1.0 (0.6-1.6)</td>
<td>0.867</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.
Table 46 Mean rates (with 95% confidence intervals) of exposure from Poisson regression to non-core advertising by setting with rate ratios (with 95% confidence intervals) comparing exposure rates within demographic groups

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Outdoor recreation</th>
<th>Sport</th>
<th>Public transport facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95%CI)</td>
<td>Rate ratio (95%CI)</td>
<td>P value</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>0.0 (0.0-0.1)</td>
<td>1.0</td>
<td>0.0 (0.0-0.1)</td>
</tr>
<tr>
<td>Māori</td>
<td>0.5 (0.1-2.5)</td>
<td>84.9 (5.9-1229.7)</td>
<td>0.003</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.0 (0.0-0.0)</td>
<td>0.0 (0.0-0.0)</td>
<td>0.000</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.0 (0.0-0.3)</td>
<td>1.0</td>
<td>0.1 (0.0-0.4)</td>
</tr>
<tr>
<td>Medium</td>
<td>0.0 (0.0-0.0)</td>
<td>0.0 (0.0-0.0)</td>
<td>0.000</td>
</tr>
<tr>
<td>High</td>
<td>0.1 (0.0-0.9)</td>
<td>3.0 (0.2-60.1)</td>
<td>0.449</td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>0.1 (0.0-0.8)</td>
<td>1.0</td>
<td>0.2 (0.1-0.5)</td>
</tr>
<tr>
<td>Overweight</td>
<td>0.0 (0.0-0.1)</td>
<td>0.1 (0.0-1.6)</td>
<td>0.095</td>
</tr>
<tr>
<td>Obese</td>
<td>0.1 (0.0-0.5)</td>
<td>0.6 (0.0-11.7)</td>
<td>0.711</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.1 (0.0-1.0)</td>
<td>1.0</td>
<td>0.3 (0.1-0.9)</td>
</tr>
<tr>
<td>Male</td>
<td>0.0 (0.0-0.0)</td>
<td>0.1 (0.0-1.0)</td>
<td>0.052</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.
Table 47 Rate ratios (with 95% confidence intervals) from Poisson regression models for non-core exposure rates in outdoor settings accounting for school decile stratum (model 1) and ethnicity (model two)¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Street</th>
<th>Shop front</th>
<th>Fresh food market*</th>
<th>Outdoor recreation*</th>
<th>Sport*</th>
<th>Public transport facility*</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate ratio (95%CI)</td>
<td>P value</td>
<td>Rate ratio (95%CI)</td>
<td>P value</td>
<td>Rate ratio (95%CI)</td>
<td>P value</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>1.1 (0.7-1.9)</td>
<td>0.553</td>
<td>1.3 (0.7-2.3)</td>
<td>0.399</td>
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<td></td>
</tr>
<tr>
<td>Pacific</td>
<td>0.6 (0.2-1.9)</td>
<td>0.401</td>
<td>1.0 (0.6-1.7)</td>
<td>0.936</td>
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<td>School decile stratum</td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
<td>1.0</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Medium</td>
<td>2.3 (1.2-4.6)</td>
<td>0.018</td>
<td>1.1 (0.7-1.7)</td>
<td>0.773</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High</td>
<td>1.6 (0.8-3.1)</td>
<td>0.146</td>
<td>0.7 (0.4-1.2)</td>
<td>0.183</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.

* Due to the small number of observations (exposures) in the data, analyses could not be performed for these settings.
### Table 48: Mean rates (with 95% confidence intervals) of exposure from Poisson regression for core advertising by outdoor setting with rate ratios (with 95% confidence intervals) comparing exposure rates within demographic groups

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Street</th>
<th>Shop front</th>
<th>Fresh food market</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95%CI)</td>
<td>p value</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>0.2 (0.1-0.4)</td>
<td>1.0</td>
<td>0.3 (0.2-0.5)</td>
</tr>
<tr>
<td>Māori</td>
<td>0.2 (0.1-0.5)</td>
<td>0.9 (0.4-1.9)</td>
<td>0.747</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.1 (0.0-0.6)</td>
<td>0.6 (0.1-3.6)</td>
<td>0.590</td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.1 (0.0-0.2)</td>
<td>1.0</td>
<td>0.5 (0.3-0.9)</td>
</tr>
<tr>
<td>Medium</td>
<td>0.3 (0.1-0.7)</td>
<td>3.9 (0.8-18.7)</td>
<td>0.088</td>
</tr>
<tr>
<td>High</td>
<td>0.2 (0.1-0.4)</td>
<td>2.9 (0.7-12.3)</td>
<td>0.134</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>0.2 (0.1-0.4)</td>
<td>1.0</td>
<td>0.3 (0.2-0.4)</td>
</tr>
<tr>
<td>Overweight</td>
<td>0.2 (0.1-0.6)</td>
<td>0.8 (0.3-2.2)</td>
<td>0.620</td>
</tr>
<tr>
<td>Obese</td>
<td>0.2 (0.1-0.6)</td>
<td>0.9 (0.3-3.3)</td>
<td>0.890</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.2 (0.1-0.4)</td>
<td>1.0</td>
<td>0.4 (0.2-0.5)</td>
</tr>
<tr>
<td>Male</td>
<td>0.1 (0.0-0.5)</td>
<td>0.6 (0.2-2.4)</td>
<td>0.491</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.
Table 49 Mean rates (with 95% confidence intervals) of exposure from Poisson regression for core advertising by outdoor setting with rate ratios (with 95% confidence intervals) comparing exposure rates within demographic groups¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Outdoor recreation</th>
<th>Sport</th>
<th>Public transport facilities</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95%CI)</td>
<td>Rate ratio (95%CI)</td>
<td>p value</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>- (-)</td>
<td>0.0 (0.0-0.0)</td>
<td>1.0</td>
</tr>
<tr>
<td>Māori</td>
<td>- (-)</td>
<td>0.1 (0.1-0.1)</td>
<td>4.98e+08 (2.43e+08 - 02e+09)</td>
</tr>
<tr>
<td>Pacific</td>
<td>- (-)</td>
<td>0.0 (0.0-0.0)</td>
<td>2.0 (0.9-4.2)</td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>- (-)</td>
<td>0.0 (0.0-0.0)</td>
<td>1.0</td>
</tr>
<tr>
<td>Medium</td>
<td>- (-)</td>
<td>0.0 (0.0-0.0)</td>
<td>0.9 (0.3-2.2)</td>
</tr>
<tr>
<td>High</td>
<td>- (-)</td>
<td>0.0 (0.0-0.0)</td>
<td>1.63e+07 (8333886-3.17e+07)</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>- (-)</td>
<td>0.0 (0.0-0.0)</td>
<td>1.0</td>
</tr>
<tr>
<td>Overweight</td>
<td>- (-)</td>
<td>0.0 (0.0-0.0)</td>
<td>0.0 (0.0-0.0)</td>
</tr>
<tr>
<td>Obese</td>
<td>- (-)</td>
<td>0.0 (0.0-0.0)</td>
<td>0.0 (0.0-0.0)</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>- (-)</td>
<td>0.0 (0.0-0.1)</td>
<td>1.0</td>
</tr>
<tr>
<td>Male</td>
<td>- (-)</td>
<td>0.0 (0.0-0.1)</td>
<td>0.9 (0.0-53.4)</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children
Table 50 Rate ratios (with 95% confidence intervals) from Poisson regression models for core exposure rates in outdoor settings accounting for school decile stratum (model 1) and ethnicity (model two)¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Street Rate ratio (95%CI)</th>
<th>p value</th>
<th>Shop front Rate ratio (95%CI)</th>
<th>p value</th>
<th>Fresh food market Rate ratio (95%CI)</th>
<th>p value</th>
<th>Outdoor recreation Rate ratio (95%CI)</th>
<th>p value</th>
<th>Sport Rate ratio (95%CI)</th>
<th>p value</th>
<th>Public transport facility Rate ratio (95%CI)</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>Mean rate 0.0</td>
<td></td>
<td>Mean rate 0.0</td>
<td></td>
<td>Mean rate 0.0</td>
<td></td>
<td>Mean rate 0.0</td>
<td></td>
</tr>
<tr>
<td>Māori</td>
<td>1.1 (0.5-2.3)</td>
<td>0.852</td>
<td>1.4 (0.5-4.3)</td>
<td>0.529</td>
<td>4.9 (0.4-67.3)</td>
<td>0.216</td>
<td>0.6 (0.3-1.5)</td>
<td>0.285</td>
<td>2.1 (0.1-35.7)</td>
<td>0.593</td>
<td>0.7 (0.1-8.8)</td>
<td>0.804</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.9 (0.1-5.8)</td>
<td>0.913</td>
<td>0.9 (0.4-1.9)</td>
<td>0.685</td>
<td>7.6 (0.1-439.9)</td>
<td>0.308</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children
Table 51 Mean rates (with 95% confidence intervals) of exposure and rate ratios (with 95% confidence intervals) from Poisson regression comparing rates of non-core product exposure by, ethnicity, school decile stratum, BMI category and gender¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Fast food</th>
<th></th>
<th>Sugary drinks</th>
<th></th>
<th>Ice cream</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95% CI)</td>
<td>p value</td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95% CI)</td>
<td>p value</td>
</tr>
<tr>
<td><strong>Ethnicity</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>3.0 (2.1-4.3)</td>
<td>1.0</td>
<td>1.1 (0.8-1.5)</td>
<td>1.0</td>
<td>1.1 (0.7-1.9)</td>
<td>1.0</td>
</tr>
<tr>
<td>Māori</td>
<td>5.7 (3.8-8.6)</td>
<td>1.9 (1.1-3.3)</td>
<td>0.020</td>
<td>1.4 (1.0-2.0)</td>
<td>1.3 (0.8-2.0)</td>
<td>0.281</td>
</tr>
<tr>
<td>Pacific</td>
<td>3.9 (2.2-6.9)</td>
<td>1.3 (0.7-2.5)</td>
<td>0.442</td>
<td>1.0 (0.6-1.6)</td>
<td>0.9 (0.5-1.5)</td>
<td>0.646</td>
</tr>
<tr>
<td><strong>School decile stratum</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>4.1 (2.8-6.1)</td>
<td>1.0</td>
<td>1.3 (0.7-2.2)</td>
<td>1.0</td>
<td>0.8 (0.5-1.5)</td>
<td>1.0</td>
</tr>
<tr>
<td>Medium</td>
<td>4.2 (3.5-5.1)</td>
<td>1.0 (0.7-1.6)</td>
<td>0.895</td>
<td>1.1 (0.5-2.6)</td>
<td>0.9 (0.3-2.4)</td>
<td>0.814</td>
</tr>
<tr>
<td>High</td>
<td>3.1 (2.0-4.9)</td>
<td>0.8 (0.4-1.4)</td>
<td>0.344</td>
<td>1.1 (0.9-1.4)</td>
<td>0.9 (0.5-1.6)</td>
<td>0.637</td>
</tr>
<tr>
<td><strong>BMI category</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>3.7 (2.8-4.8)</td>
<td>1.0</td>
<td>0.9 (0.6-1.6)</td>
<td>1.0</td>
<td>1.0 (0.7-1.3)</td>
<td>1.0</td>
</tr>
<tr>
<td>Overweight</td>
<td>2.2 (1.2-4.0)</td>
<td>0.6 (0.4-1.0)</td>
<td>0.037</td>
<td>1.6 (0.6-4.2)</td>
<td>1.7 (0.4-6.8)</td>
<td>0.443</td>
</tr>
<tr>
<td>Obese</td>
<td>5.6 (3.1-10.0)</td>
<td>1.5 (0.9-2.6)</td>
<td>0.113</td>
<td>2.2 (1.2-3.5)</td>
<td>2.2 (1.0-4.6)</td>
<td>0.047</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>3.7 (2.5-5.5)</td>
<td>1.0</td>
<td>0.9 (0.6-1.5)</td>
<td>1.0</td>
<td>0.9 (0.5-1.5)</td>
<td>1.0</td>
</tr>
<tr>
<td>Male</td>
<td>3.2 (2.3-4.3)</td>
<td>0.8 (0.6-1.2)</td>
<td>0.335</td>
<td>1.4 (0.7-2.8)</td>
<td>1.5 (0.5-4.3)</td>
<td>0.415</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children
Table 52 Mean rates (with 95% confidence intervals) of exposure and rate ratios (with 95% confidence intervals) from Poisson regression comparing rates of non-core product exposure by, ethnicity, school decile stratum, BMI category and gender¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Cookies</th>
<th>Confectionery</th>
<th>Snack foods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean rate per hour (95% CI)</td>
<td>Rate ratio (95% CI)</td>
<td>P value</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>0.6 (0.3-1.1)</td>
<td>1.0</td>
<td>0.2 (0.1-1.0)</td>
</tr>
<tr>
<td>Māori</td>
<td>0.8 (0.4-1.6)</td>
<td>1.4 (0.6-3.4)</td>
<td>0.426</td>
</tr>
<tr>
<td>Pacific</td>
<td>0.6 (0.2-1.7)</td>
<td>1.2 (0.3-3.5)</td>
<td>0.922</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>0.7 (0.3-1.7)</td>
<td>1.0</td>
<td>0.2 (0.1-0.5)</td>
</tr>
<tr>
<td>Medium</td>
<td>0.8 (0.5-1.3)</td>
<td>1.2 (0.4-3.1)</td>
<td>0.735</td>
</tr>
<tr>
<td>High</td>
<td>0.6 (0.2-1.3)</td>
<td>0.8 (0.2-2.6)</td>
<td>0.475</td>
</tr>
<tr>
<td>BMI category</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Healthy</td>
<td>0.6 (0.4-0.8)</td>
<td>1.0</td>
<td>0.2 (0.1-0.9)</td>
</tr>
<tr>
<td>Overweight</td>
<td>0.6 (0.2-2.2)</td>
<td>1.1 (0.4-3.2)</td>
<td>0.852</td>
</tr>
<tr>
<td>Obese</td>
<td>0.8 (0.4-1.5)</td>
<td>1.3 (0.6-3.0)</td>
<td>0.535</td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>0.6 (0.4-1.0)</td>
<td>1.0</td>
<td>0.4 (0.1-1.0)</td>
</tr>
<tr>
<td>Male</td>
<td>0.6 (0.3-1.6)</td>
<td>1.0 (0.5-2.1)</td>
<td>0.902</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children
Table 53 Rate ratios (with 95% confidence intervals) from Poisson regression models for exposure rates by non-core food product category in outdoor settings accounting for school decile stratum (model 1) and ethnicity (model two)¹

<table>
<thead>
<tr>
<th>Demographic factor</th>
<th>Fast food</th>
<th>Sugary drinks</th>
<th>Ice cream</th>
<th>Cookies</th>
<th>Confectionery</th>
<th>Snack foods</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rate ratio (95%CI)</td>
<td>P value</td>
<td>Rate ratio (95%CI)</td>
<td>P value</td>
<td>Rate ratio (95%CI)</td>
<td>P value</td>
</tr>
<tr>
<td>Ethnicity</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>NZE</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Māori</td>
<td>1.9 (1.0-3.5)</td>
<td>0.040</td>
<td>1.2 (0.7-2.0)</td>
<td>0.406</td>
<td>0.7 (0.4-1.2)</td>
<td>0.185</td>
</tr>
<tr>
<td>Pacific</td>
<td>1.3 (0.7-2.5)</td>
<td>0.409</td>
<td>0.8 (0.4-1.5)</td>
<td>0.530</td>
<td>0.7 (0.3-1.8)</td>
<td>0.481</td>
</tr>
<tr>
<td>School decile stratum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
<td>1.0</td>
</tr>
<tr>
<td>Medium</td>
<td>1.3 (0.8-2.1)</td>
<td>0.295</td>
<td>0.9 (0.4-2.1)</td>
<td>0.774</td>
<td>1.9 (1.0-3.8)</td>
<td>0.064</td>
</tr>
<tr>
<td>High</td>
<td>1.0 (0.5-1.8)</td>
<td>0.991</td>
<td>0.9 (0.5-1.6)</td>
<td>0.646</td>
<td>0.9 (0.4-2.0)</td>
<td>0.709</td>
</tr>
</tbody>
</table>

¹ Rates were calculated accounting for the complex sampling design and were weighted to account for the oversampling of Māori and Pacific children.